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The Great Basin Naturalist

VOLUME XV, 1955

Vasco M. Tanner, *Editor*

Published at Provo, Utah, by
The Department of Zoology and Entomology
of Brigham Young University

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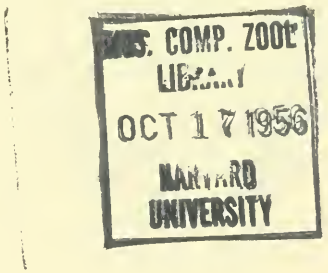
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DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY
BRIGHAM YOUNG UNIVERSITY

The Great Basin Naturalist

A journal published from one to four times a year by the Department of Zoology and Entomology, Brigham Young University, Provo, Utah.

Manuscripts: Only original unpublished manuscripts, pertaining to the Great Basin and the Western United States in the main, will be accepted. Manuscripts are subject to the approval of the editor.

Illustrations: All illustrations should be made with a view to having them appear within limits of the printed page. The illustrations that form a part of an article should accompany the manuscript. All half-tones or zinc etchings to appear in this journal are to be made under the supervision of the editor, and the cost of the cuts is to be borne by the contributor.

Reprints: No reprints are furnished free of charge. A price list for reprints and an order form is sent with the proof.

Subscriptions: The annual subscription is $2.50, (outside the United States $3.25). Single number, 80 cents.

All correspondence dealing with manuscripts, subscriptions, reprints and other business matters should be addressed to the Editor, Vasco M. Tanner, Great Basin Naturalist, Brigham Young University, Provo, Utah.

Reprints Schedule of The Great Basin Naturalist

	2 pp.	4 pp.	6 pp.	8 pp.	10 pp.	12 pp.	Each Additional 2 pp.
50 copies	$3.25	$4.75	$5.75	$6.75	$7.75	$8.75	$1.50
100 copies	4.75	5.75	6.75	7.75	8.75	9.75	
200 copies	6.00	7.00	8.00	9.00	10.00	11.00	
300 copies	7.00	8.00	9.00	10.00	11.00	12.00	

Covers: $6.00 for first 100 copies; $2.50 for additional 100 copies.

The Great Basin Naturalist

Published by the
Department of Zoology and Entomology
Brigham Young University, Provo, Utah

Volume XV DECEMBER 31, 1955 Nos. 1-4

THE CHIGGERS OF UTAH (ACARINA: TROMBICULIDAE)

James M. Brennan[1] and D Elden Beck[2]

In conjunction with an ectoparasite survey in Utah, numerous lots of larval trombiculid mites were collected.[3] These are the basis for the present and first report on Utah chiggers. Principal collectors were the junior author, who supervised the survey, Dr. Dorald M. Allred, Mr. Merlin Killpack and Mr. Marvin Coffey.

Several records, in addition to those from the survey, were provided by the Rocky Mountain Laboratory, the University of Kansas, and the Dugway Proving Ground. These are indicated parenthetically in the text as RML, KU, and DPG immediately after the pertinent records.

Thirty-eight species, the majority from rodents, are recorded along with condensed collecting data. Eight of these are described as new. A key is given to all species included, and generalized geographic data outside of Utah provided. *Acomatacarus sexacis* Allred and Beck is reduced to snyoymy under *A. micheneri* Greenberg, and *Trombicula imperfecta* Brennan and Jones under *T. hoplai* Loomis.

KEY TO SPECIES

1.	Leg segmentation 6-6-6; scutal setae 6; coxa I with 2 setae; sensillae flagelliform	2
	Leg segmentation 7-7-7; scutal setae 5; coxa I with 1 seta; sensillae flagelliform or expanded	8
	Leg segmentation 7-6-6; scutal setae 4; coxa I with 1 seta; sensillae expanded	*Walchia americana*
2.	Tarsi lacking empodia	*Chatia setosa*
	Tarsi with empodia	3
3.	Scutum with anteromedian projection	4
	Scutum without anteromedian projection	7
4.	Tarsala II expanded distally	*Acomatacarus arizonensis*
	Tarsala II not expanded distally	5
5.	Sensillae branched; no tarsala III	*Acomatacarus linsdalci*
	Sensillae nude; with tarsala III	6

1. From the U. S. Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health, National Microbiological Institute, Rocky Mountain Laboratory, Hamilton, Montana.
2. Department of Zoology and Entomology, Brigham Young University, Provo, Utah.
3. From 1950 through 1954, the junior author conducted surveys throughout Utah relative to vectors of Rocky Mountain spotted fever and plague. This study was supported in part by a research grant from the National Institutes of Health.

6. One genuala I ..... *Acomatacarus micheneri*
Two genualae ..... *Acomatacarus hirsutus*
7(3). Spiracles and tracheae present; cheliceral blades with rows of teeth; coxa III with 1 seta ..... *Whartonia perplexa*
Spiracles and tracheae absent; cheliceral blades with teeth confined to tricuspid cap; coxa III multisetose ..... *Shunsennia ochotona*
8(1). Sensillae flagelliform 9
Sensillae expanded 21
9. Palpal tibial claw bifurcate ..... *Trombicula belkini*
Palpal tibial claw trifurcate 10
10. Subterminala, and genualae II and III lacking ..... *Trombicula hoplai*
Subterminala, and genualae II and III present 11
11. Mastifemoralae, mastitibialae, and mastitarsalae present 12
Mastifemoralae and mastitibialae absent, mastitarsalae present or absent 14
12. Sensillae nude ..... *Trombicula californica*
Sensillae branched 13
13. Galeal seta nude ..... *Trombicula harperi*
Galeal seta branched ..... *Trombicula microti*
14(11). Coxa III with 1 seta 15
Coxa III with 2 or more setae 19
15. Parasubterminala lacking ..... *Trombicula doremi* n.sp.
Parasubterminala present 16
16. Mastitarsalae III present; parasubterminala branched ..... *Trombicula allredi* n.sp.
Mastitarsalae III absent; parasubterminala nude 17
17. Three genualae I ..... *Trombicula kardosi*
Two genualae I 18
18. Palpal dorsotibial seta nude ..... *Trombicula potosina*
Palpal dorsotibial seta branched ..... *Trombicula myotis*
19(14). Scutum distinctly pentagonal; sensillae basally barbed as well as distally branched ..... *Trombicula sargenti*
Scutum not pentagonal; sensillae only distally branched 20
20. First dorsal row with 6 setae ..... *Trombicula montanensis*
First dorsal row with 8 setae ..... *Trombicula arenicola*
21(8). Cuticular striae encroach on submerged scutum, forming a definite pattern ..... *Neoschöngastia americana*
Scutum not submerged 22
22. Tibiala III present 23
Tibiala III absent 27
23. Sternal setae 2-4 ..... *Euschöngastia cordiremus*
Sternal setae 2-2 24
24. Subterminala and parasubterminala present 25
Subterminala and parasubterminala absent 26
25. Genualae II and III present ..... *Euschöngastia oregonensis*
Genualae II and III absent ..... *Euschöngastia utahensis* n.sp.
26. One genuala I, genualae II and III absent ..... *Euschöngastia lacerta*
Two genualae I, genualae II and III present ..... *Euschöngastia* "h" n. sp.
27(22). Subterminala and parasubterminala present 28
Subterminala and parasubterminala absent ..... *Euschöngastia fasolla* n.sp.
28. Dorsal setae lanceolate ..... *Euschöngastia lanceolata* n.sp.
Dorsal setae not lanceolate 29
29. Genualae II and III present 30
Genualae II and III absent 36

30. Two pairs of humeral setae; spherical when engorged ..... *Euschöngastia rotunda* n.sp.
One pair of humeral setae; not spherical when engorged 31
31. Anterolateral setae of scutum as long as or longer than posterolateral setae 32
Anterolateral setae of scutum shorter than posterolateral setae 33
32. One genuala I ..... *Euschöngastia* "d" n.sp.
Two genualae I ..... *Euschöngastia radfordi*
33. Cheliceral bases, scutum, and legs impunctate 34
Cheliceral bases, scutum, and legs punctate 35
34. Palpal tibial claw usually with 5 prongs; sensillae obcordate ..... *Euschöngastia sciuricola*
Palpal tibial claw with 3 prongs; sensillae spatulate-clavate ..... *Euschöngastia criceticola*
35. One genuala I ..... *Euschöngastia lanei* n.sp.
Two genualae I ..... *Euschöngastia obesa* n.sp.
36(29). Palpal tibial claw with 5 prongs .... *Euschöngastia pomerantzi*
Palpal tibial claw with 3 prongs ..... *Euschöngastia luteodema*

SPECIES RECORDED

TROMBICULA (EUTROMBICULA) BELKINI Gould

Trombicula (Eutrombicula) belkini Gould, 1950, p. 367.

DUCHESNE COUNTY: From *Citellus leucurus*, 23 August 1953, 2 specimens identified. EMERY COUNTY: *Crotaphytus collaris*, no date, 4. GARFIELD COUNTY: *Crotaphytus collaris*, 16 May 1954, 1. GRAND COUNTY: *Crotaphytus collaris*, 28, June 1950, 8 (KU); *Cnemidophorus tigris*, 28 June 1950, 1 (KU). JUAB COUNTY: *Gambelia wislizenii*, 30 June 1949, 4; *Uta stansburiana*, 7 July 1949, 10; *Peromyscus truei* 14 July 1951, 1. MILLARD COUNTY: *Sceloporus graciosus*, 19 July 1949, 5. SEVIER COUNTY: *Citellus lateralis*, 4 August 1952, 1. UTAH COUNTY: *Sceloporus graciosus*, 19 July 1949, 5.

T. belkini has also been recorded from California, and specimens are on hand from Oregon and Arizona. The species has been recorded as attacking man in California (Gould, 1950).

TROMBICULA (LEPTOTROMBIDIUM) MYOTIS Ewing

Trombicula myotis Ewing, 1929, p. 294.

UTAH COUNTY: From *Myotis californicus*, 4 June 1949, 15 specimens identified.

This common chigger has also been recorded from Maine, Pennsylvania, Alberta *(Peromyscus)*, Montana, California, and Korea. Specimens are on hand from Ontario, New York, Arkansas, and New Mexico *(Sigmodon)*.

TROMBICULA (LEPTOTROMBIDIUM) POTOSINA Hoffman

Trombicula potosina Hoffman, 1950, p. 151

BEAVER COUNTY: From *Perognathus parvus*, 10 July 1952, 1 specimen identified. IRON COUNTY: *Neotoma lepida*, 4 September 1951 and 18 July 1953, 20. JUAB COUNTY: *Neotoma lepida*, 14 July 1951 and 13 August 1953, 22. MILLARD COUNTY: *Neotoma lepida*, 15 August 1953, 8. SAN JUAN COUNTY: *Neotoma* sp., 28 August 1953, 3. SANPETE COUNTY: *Microtus longicaudus*, 2 August 1951, 10. TOOELE

COUNTY: *Neotoma lepida*, 8 August 1951 and 25 August 1954, 30 (DPG). WASHINGTON COUNTY: *Neotoma lepida*, 13 August 1953, 14.

T. potosina was described from *Neotoma micropus*, San Luis Potosi, Mexico. The Utah specimens compare favorably with the Hoffman paratypes. Differences are negligible and within the limits of variation. The above data constitute the first records of the species in the United States.

TROMBICULA (NEOTROMBICULA) CALIFORNICA Ewing

Trombicula californicia Ewing, 1942, p. 488.

CACHE COUNTY: From *Peromyscus maniculatus*, 2 July 1953, 1 specimen identified (KU). RICH COUNTY: *Clethrionomys gapperi*, 24 June 1953, 3; *Microtus longicaudus*, 24 June 1953, 1. SANPETE COUNTY: *Citellus armatus*, 1 August 1951, 10.

T. californica has also been recorded from California, Montana, and Idaho.

TROMBICULA (NEOTROMBICULA) HARPERI Ewing

Trombicula harperi Ewing, 1928, p. 79.

BEAVER COUNTY: From *Ochotona princeps*, no date, 3 specimens identified. JUAB COUNTY: *Gambelia* sp., 23 June 1951, 10. SANPETE COUNTY: *Citellus armatus*, 1 and 2 August 1951, 14; *Clethrionomys gapperi*, 1 August 1951, 3; *Marmota flaviventer*, 1 August 1951, 4; *Microtus longicaudus*, 2 August 1951, 1; *Zapus princeps*, 1 and 2 August 1951, 28. SEVIER COUNTY: *Microtus* sp., 23 July 1953, 1. UTAH COUNTY: *Ochotona princeps*, 8 November 1952, 18. WASATCH COUNTY: *Zapus princeps*, 1 July 1953, 5.

T. harperi has also been recorded from New York, Main, Pennsylvania, Wyoming, Colorado, Montana, and Idaho. In the Rocky Mountain Laboratory is unrecorded material from Michigan, New Mexico, and Arizona.

TROMBICULA (NEOTROMBICULA) MICROTI Ewing

Trombicula microti Ewing, 1928, p. 80.

BEAVER COUNTY: From *Ochotona princeps*, 22 July 1953, 3 specimens identified. DUCHESNE COUNTY: *Ochotona princeps*, 2 September 1952, 18. IRON COUNTY: *Ochotona princeps*, 18 and 20 July 1953, 17. JUAB COUNTY: *Neotoma lepida*, 14 July 1951, 6. SANPETE COUNTY: *Microtus longicaudus*, 2 August 1951, 2; *Zapus princeps*, 1 and 2 August 1951, 2. SEVIER COUNTY: *Microtus* sp., 23 July 1953, 1. SUMMIT COUNTY: *Ochotona princeps*, 2 August 1952, 4 (KU). TOOELE COUNTY: *Melospiza lincolni*, 24 September 1953, 3 (DPG). WASATCH COUNTY: *Ochotona princeps*, 7 August 1953, 5. WAYNE COUNTY: *Ochotona princeps*, 9 August 1952, 18.

Also recorded from Wyoming, Colorado, New Mexico, Montana, Washington, Oregon, California, Labrador, Vermont, Ontario, Island of St. Lawrence River, Alberta, Eastern Manchuria, and Japan (Hokkaido and Honshu). Unrecorded specimens are in the Rocky Mountain Laboratory from Michigan and Afognak Island, Alaska.

TROMBICULA (MIYATROMBICULA) SARGENTI Brennan

Trombicula sargenti Brennan, 1952, p. 61.

In addition to the type series from *Neotoma* sp., Juab County, 14 October 1951, this species has been reported from nests of *Neotoma lepida*, Juab and Utah Counties, October and November 1951, by Allred and Beck (1953).

TROMBICULA HOPLAI Loomis

Trombicula (Euschöngastoides) hoplai Loomis, 1954, p. 924.
Trombicula imperfecta Brennan and Jones, 1954, p. 186. New synonymy.

JUAB COUNTY: From *Peromyscus truei*, 4 August 1953, 1 specimen identified (DPG). SAN JUAN COUNTY: *Perognathus apache*, 26 August 1953, 5.

This distinctive species has also been recorded from Kansas, Colorado, New Mexico, Texas, and California.

An examination of the type material of *T. hoplai* and *T. imperfecta* by both Dr. Loomis and the senior author has revealed no specific differences.

TROMBICULA ARENICOLA Loomis

Trombicula arenicola Loomis, 1954, p. 930.

BOX ELDER COUNTY: From *Perognathus* sp., 18 and 19 June 1952, 15 specimens identified; *Dipodomys* sp., 18 June 1952, 10; *Neotoma lepida*, 18 June 1952, 1. DAGGET COUNTY: *Perognathus parvus*, 15 July 1954, 10. GARFIELD COUNTY: *Cynomys parvidens*, 25 July 1952, 5. GRAND COUNTY: *Perognathus* sp., 3 July 1952, 12. JUAB COUNTY: *Perognathus formosus*, 14 and 15 July 1951, 115; *Perognathus* sp., 12 August 1953, 8; *Dipodomys microps*, 12 August 1953, 6. MILLARD COUNTY: *Dipodomys microps*, 15 August 1953, 5. SANPETE COUNTY: *Peromyscus maniculatus*, 1 August 1951, 10. SEVIER COUNTY: *Dipodomys ordii*, 3 April 1952, 8. TOOELE COUNTY: *Coluber taeniatus*, 30 September 1953, 25 (DPG); *Pituophis catenifer*, 29 September 1953, 1 (DPG); *Dipodomys ordii*, 2 October to 15 November 1951, 8 July 1953, 36 (DPG); *Dipodomys microps*, 15 September to 18 October, 1951, 49 (DPG); *Perognathus formosus*, 8 July 1952, 6 (DPG); *P. parvus*, 11 August to 5 September 1951, 17 (DPG). UINTAH COUNTY: *Dipodomys ordii*, 14 August 1951, 7. UTAH COUNTY: *Dipodomys ordii*, 28 September 1950 and 14 October 1951, 7; *Perognathus parvus*, 31 August 1952, 20. WASHINGTON COUNTY: *Perognathus formosus*, 17 April 1952 and 13 July 1953, 17; *Perognathus longimembris*, 17 April 1952, 1. WAYNE COUNTY: *Dipodomys ordii*, 7 August 1952, 2.

Two of the above records are the first to establish the occurrence of *T. arenicola* on reptiles.

The species has also been recorded from Kansas, Colorado, New Mexico, and Alberta.

TROMBICULA MONTANENSIS Brennan

Trombicula montanensis Brennan, 1946, p. 441.

DUCHESNE COUNTY: From *Cynomys leucurus*, 21 August 1952, 6 specimens identified.

T. montanensis has also been recorded from Montana, Colorado, Kansas, Nebraska, Oklahoma, and Texas.

TROMBICULA KARDOSI Loomis

Trombicula kardosi Loomis, 1954, p. 929.

GARFIELD COUNTY: From *Eutamias umbrinus*, 24 September 1952, 1 specimen identified (KU).

T. kardosi was described from Kansas. No other distributional records are available.

EUSCHÖNGASTIA CORDIREMUS Brennan

Euschöngastia cordiremus Brennan, 1948, p. 470.

CACHE COUNTY: From *Peromyscus maniculatus*, 12 June 1953, 1 specimen identified (KU).

Described from Montana. In addition, specimens are on hand from California and Nevada.

EUSCHÖNGASTIA CRICETICOLA Brennan

Euschöngastia criceticola Brennan, 1948, p. 473.

EMERY COUNTY: From *Peromyscus maniculatus*, 22 May 1952, 16 specimens identified. JUAB COUNTY: *Neotoma lepida*, 13 and 14 October 1951, 45 (RML). TOOELE COUNTY: *Peromyscus maniculatus*, 30 October 1950, 13 (DPG). UTAH COUNTY: *Peromyscus boylii*, 17 March 1951, 8; *Peromyscus maniculatus*, 15 October 1949, 5; *Dipodomys ordii*, 14 October 1951, 4. WASHINGTON COUNTY: *Neotoma lepida*, 19 December 1950, 1; *Peromyscus eremicus*, 15 April 1952, 10. WAYNE COUNTY: *Peromyscus maniculatus*, 7 August 1952, 1.

This species has also been recorded from Montana, Idaho, California, and Alberta.

EUSCHÖNGASTIA "D" Gould, new species

Euschöngastia "d" Gould, (in press)

BOX ELDER COUNTY: From *Lepus californicus*, January 1952, 1 specimen identified (KU). CACHE COUNTY: *Peromyscus maniculatus*, 2 July 1953, 1 (KU). DUCHESNE COUNTY: *Citellus lateralis*, 5 April 1953, 4. GARFIELD COUNTY: *Citellus lateralis*, 19 September 1952, 1 (KU). TOOELE COUNTY: *Neotoma lepida*, 7 April 1950, 7; host ?, 29 March 1953, 5. UTAH COUNTY: *Dipodmys ordii*, 25 March 1941, 1; *Perognathus parvus*, 12 April 1950, 11; nest of *Bubo virginianus* containing remains of rabbit, 25 May 1951, 10. WASHINGTON COUNTY: *Dipodomys merriami*, 23 February 1952, 6; *Perognathus formosus*, 23 February 1952, 4; *Perognathus longimembris*, 17 April 1952, 29.

E. "d" was described from California. Additional material from Oregon and Nevada is in the Rocky Mountain Laboratory.

EUSCHÖNGASTIA "H" Gould, new species

Euschöngastia "h" Gould, (in press).

SEVIER COUNTY: From *Citellus lateralis*, 4 August 1952, 8 specimens identified.

This species was described from California. No other records are available.

EUSCHÖNGASTIA LACERTA Brennan

Euschöngastia lacerta Brennan, 1948, p. 468.

GARFIELD COUNTY: From *Neotoma lepida*, 26 July 1952, 2 specimens identified. TOOELE COUNTY: *Neotoma lepida*, 9 July 1952, 9 (DPG).

E. lacerta has been recorded also from California whence it was described from lizards.

EUSCHÖNGASTIA LUTEODEMA Brennan

Euschöngastia luteodema Brennan, 1948, p. 470.

CACHE COUNTY: From *Peromyscus maniculatus*, 13 June 2 to July 1953, 6 specimens identified (KU).

Also recorded from Montana, Idaho, and California.

EUSCHÖNGASTIA OREGONENSIS (Ewing)

Trombicula oregonensis Ewing, 1929a, p. 11

CACHE COUNTY: From *Peromyscus maniculatus*, 2 July 1953, 1 specimen identified (KU). IRON COUNTY: *Sorex obscurus*, 21 July 1953, 5; *Ochotona princeps*, 18 July 1953, 1. SEVIER COUNTY: *Microtus* sp., 23 July 1953, 3. UTAH COUNTY: *Ochotona princeps*, 8 November 1952, 17. WAYNE COUNTY: *Ochotona princeps*, 9 August 1952, 9.

E. oregonensis has also been recorded from Oregon, Montana, California, and Alberta. Specimens are on hand from Washington.

EUSCHÖNGASTIA POMERANTZI Brennan and Jones

Euschöngastia pomerantzi Brennan and Jones, 1954, p. 171.

GARFIELD COUNTY: From *Eutamias umbrinus*, 18 September 1952, 3 specimens identified (KU).

Described from California, and material is on hand from Nevada.

EUSCHÖNGASTIA RADFORDI Brennan and Jones

Euschöngastia radfordi Brennan and Jones, 1954, p. 173.

GARFIELD COUNTY: From *Erethizon dorsatum*, 19 September 1952, 2 specimens identified (KU). TOOELE COUNTY: *Junco caniceps*, 1 November 1951, 10 (DPG). WASHINGTON COUNTY: *Neotoma lepida*, 18 and 19 December 1950, 23.

This species has also been recorded from a large variety of hosts in California, Oregon, Montana, and Idaho.

EUSCHÖNGASTIA SCIURICOLA (Ewing)

Schöngastia sciuricola Ewing, 1925, p. 261.

CACHE COUNTY: From *Eutamias umbrinus*, 20 June 1953, 2 specimens identified (KU). DUCHESNE COUNTY: *Tamiasciurus hudsonicus*, 6 September 1953, 5. SANPETE COUNTY: *Citellus armatus*, 1 August 1951, 1; *Citellus lateralis*, 5 May 1951, 9. SEVIER COUNTY: *Citellus lateralis*, 5 August 1952, 10. UTAH COUNTY: *Citellus variegatus*, 27 July 1951, 10.

E. sciuricola has also been recorded from Montana, Idaho, California, and Alberta. A few specimens tentatively referred to this species are from New Mexico.

NEOSCHÖNGASTIA AMERICANA (Hirst)

Schöngastia americana Hirst, 1921, p. 37.

TOOELE COUNTY: From *Amphispiza belli*, 25 October 1953, 3 specimens identified (DPG); *Junco oreganus*, 9 October 1953, 1 (DPG); *Otocoris alpestris*, 16 August 1951, 3 (DPG); *Salpinctes obsoletus*, 27 August and 24 September 1953, 16 (DPG).

This widespread bird species (also known from lizards and rabbits) has also been recorded from "southern states," Texas, California, Virginia, South Carolina, Jamaica, Mexico, and Guatemala. Specimens are on hand from Missouri *(Sylvilagus)*. A subspecies, *solomonis*, has been recorded from the Pacific Islands: Bougainville, Guam, Iwo Jima, and Okinawa (Wharton and Hardcastle, 1946).

WALCHIA AMERICANA Ewing

Walchia americana Ewing, 1942, p. 491.

GARFIELD COUNTY: From *Eutamias umbrinus*, 24 September 1952, 1 specimen identified (KU).

W. americana has also been recorded from Florida, Wisconsin, and California. Specimens from Kansas and Oklahoma are in the Rocky Mountain Laboratory.

ACOMATACARUS ARIZONENSIS Ewing

Acomatacarus arizonensis Ewing, 1942, p. 490.

EMERY COUNTY: From *Crotaphytus collaris*, no date, 11 specimens identified. GARFIELD COUNTY: *Crotaphytus collaris*, 16 May 1954, 25. GRAND COUNTY: *Crotaphytus collaris*, 28 June 1950, 12 (KU); *Uta stansburiana*, 31 July 1940, 10 (RML). KANE COUNTY: *Crotaphytus collaris*, no date, 6. JUAB COUNTY: *Gambelia wislizenii*, 30 June 1949, 6.

Also recorded from Arizona, California, and Mexico.

ACOMATACARUS HIRSUTUS (Ewing)

Hannemania hirsuta Ewing, 1931, p. 17.

GRAND COUNTY: From *Neotoma* sp., 10 May 1950, 5 specimens identified.

This species was described from California. No other distributional records are available.

ACOMATACARUS LINSDALEI Brennan and Jones

Acomatacarus linsdalei Brennan and Jones, 1954, p. 160.

BEAVER COUNTY: From *Dipodomys ordii* and *D. microps*, 9 and 11 September 1950, 20 specimens identified; *Perognathus parvus*, 10 July 1952, 5. JUAB COUNTY: *Perognathus formosus*, 14 July 1951, 1. TOOELE COUNTY: *Perognathus parvus*, 10 and 11 August 1951, 2 (DPG). UTAH COUNTY: *Perognathus parvus*, 1 November 1952, 2. WASHINGTON COUNTY: *Neotoma lepida*, 19 December 1950, 2.

In addition, *A. linsdalei* has been recorded only from California.

ACOMATACARUS MICHENERI Greenberg

Acomatacarus micheneri Greenberg, 1952, p. 480.
Acomatacarus sexacis Allred and Beck, 1953a, p. 87. New synonymy.

BOX ELDER COUNTY: From *Neotoma lepida*, 18 and 20 June 1952, 23 specimens identified; *Sylvilagus* sp., 19 June 1952, 10. GARFIELD COUNTY: *Neotoma lepida*, 26 July 1952, 5; *Perognathus parvus*, 25 July 1952, 5. GRAND COUNTY: *Neotoma lepida*, 14 July 1950, 5. PIUTE COUNTY: *Neotoma lepida*, 26 June 1952, 5. TOOELE COUNTY: *Neotoma lepida*, 9 July 1952, 3 (DPG); *Neotoma cinerea*, 22 and 27 July 1950, 17. WASHINGTON COUNTY: *Neotoma lepida*, 13 and 16 July 1953, 2.

The senior author has examined paratypes of both *A. micheneri* and *A. sexacis* and has found no differences of specific consequence. The comparative diagnostic characters given by Allred and Beck (1953a) are only the expected variations within different populations. The species was described from Colorado. No other records are available.

CHATIA SETOSA Brennan

Chatia setosa Brennan, 1946a, p. 132.

CACHE COUNTY: From *Peromyscus maniculatus*, 11 and 26 June, 2 July 1953, 14 specimens identified (KU).

C. setosa has also been recorded from Montana, Idaho, Washington, and California.

SHUNSENNIA OCHOTONA (Radford)

Hannemania ochotrona [sic] Radford, 1942, p. 72.

CACHE COUNTY: From *Peromyscus maniculatus*, 11, 13, and 26 June 1953, 56 specimens identified (KU). TOOELE COUNTY: *Neotoma cinerea*, 22 July 1951, 1.

Recorded also from Montana and California. Specimens are on hand from Idaho and Nevada.

WHARTONIA PERPLEXA (Brennan)

Hannemania perplexa Brennan, 1947, p. 248.

SAN JUAN COUNTY: From *Myotis californicus*, 4 May 1951, 2 specimens identified. SALT LAKE COUNTY: *Antrozous pallidus*, October 1948, 2 (RML).

This bat chigger has also been recorded from Montana and California.

TROMBICULA **ALLREDI** Brennan and Beck, n. sp.

(Fig. 1, E-H)

BODY: Subellipsodial. Length and width of holotype, partly engorged, 546 by 305 microns. Eyes large, 2/2, no ocular plate. Anus at level of fourth row of ventral setae.

GNATHOSOMA: Cheliceral bases and capitular sternum heavily punctate. Few indistinct puncta on femoral plate of palp. Cheliceral blade with tricuspid cap. Setae of capitular sternum, all palpal setae, and galeal setae strongly branched. Palpal claw trifurcate. Palpal tarsus with 6 branched setae, a small nude seta and a small tarsala.

SCUTUM: Shaped as figured, somewhat less than 2 times as wide as long, puncta few, large and distributed as figured. Sensillary bases

at about the level of the posterolateral setae and separated by a little less than the distance from either to its corresponding posterolateral seta. Sensillae flagelliform, sparsely branched on apical half and with minute barbs on basal half. Setae with appressed branches. Scutal measurements of holotype: AW-72, PW-88, SB-25, ASB-29, PSB-21, AP-21, AM-28, AL-29, PL-40, S-64.

Legs: All segments with few, scattered puncta. Leg I coxa, trochanter and basifemur each with a branched seta; telofemur with 5 branched setae; genu with 4 branched setae, 3 long genualae, and a microgenuala; tibia with 8 branched setae, 2 very short, nearly identical, approximate tibialae, and a microtibiala; tarsus with about 20 branched setae, a prominent tarsala, a microtarsala, a subterminala, a branched parsubterminala, and a pretarsala. Leg II coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 4 branched setae; genu with 3 branched setae and a genuala; tibia with 6 branched setae and 2 very short, approximate tibialae; tarsus with about 16 branched setae, a tarsala (longer and thinner than tarsala I), a microtarsala, and a pretarsala. Leg III coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 3 branched setae; genu with 3 branched setae and a genuala; tibia with 6 branched setae and a tibiala; tarsus with about 12 branched setae and 2 mastitarsalae each having 1 or 2 delicate branches basally. All tarsi terminated by a pair of claws with a clawlike empodium between.

Body setae: Dorsal setae 30 to 38 microns in length, the longer ones marginal. They are fairly straight, seemingly stiff, and have appressed branches. Dorsal formula for the holotype: 2-6-6-4-4-2-2. Ventral setae 2-2 (sternals) plus about 36. Those of the posterior rows similar to the dorsal setae.

Type data: Type series all from *Neotoma lepida* (wood rat), Washington County, Utah. Holotype and 4 paratypes RML No. 33182, Rockville, 13 July 1953; 3 paratypes, No. 33184, Diamond Valley, 16 July 1953; 6 paratypes, No. 31208, 2 miles west of Toquerville, 5 September 1951.

Holotype and some paratypes in the collection of the Rocky Mountain Laboratory. Other paratypes in the Brigham Young University, the United States National Museum, the British Museum (Natural History), the South Australian Museum, and the University of Kansas.

Diagnosis: The branched parasubterminala, 3 genualae I, very small tibialae I and II, and 2 mastitarsalae III distinguish *T. allredi* n. sp. from other members of the genus.

This species is named for Dr. Dorald M. Allred who collected some of the material on which this paper is based.

TROMBICULA **DOREMI**, Brennan and Beck, n. sp.
(Fig. 1, A-D)

Body: Ellipsoidal. Length and width of holotype, nearly engorged, 520 by 332 microns. Eyes large, 2/2, anterior and posterior

eyes sub-equal in size, no ocular plate. Anus at level of fourth row of ventral seate.

Gnathosoma: Cheliveral bases, capitular sternum and femoral plate of palpi with few scattered puncta. Blade of chelicera with tricuspid cap. Setae of capitular sternum heavily branched. Palpal setae: Femoral and genual with many coarse branches, dorsal and lateral tibial nude, ventral tibial with about 10 branches. Palpal claw trifurcate. Palpal tarsus with 7 branched setae and a small tarsala. Galeal seta branched.

Scutum: Roughly pentagonal about 1½ times wider than long, posterior margin rounded, puncta conspicuous but not numerous. Sensillary bases anterior to the level of the posterolateral setae and separated by less than the distance from either to its corresponding posterolateral seta. Sensillae flagelliform, branched on apical third. Scutal setae thick, plumose. Scutal measurements of holotype: AW-77, PW-88, SB-25, ASB-32, PSB-29, AP-22, AM-35, AL-32, PL-29, S-75.

Legs: All leg segments punctate. Setae as follows: Leg I coxa, trochanter and basifemur each with a branched seta; telofemur with 5 branched setae; genu with 4 branched setae, 3 moderately long genualae and a microgenuala; tibia with 8 branched setae, 2 approximate tibialae of equal length and form, shorter than the genualae, and a microtibiala; tarsus with about 18 branched setae, a large tarsala, microtarsala, a subterminala, no parasubterminala, and a pretarsala Leg II coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 4 branched setae; genu with 3 branched setae and a genuala; tibia with 6 branched setae and 2 approximate and identical tibialae; tarsus with about 15 banched setae, a tarsala (smaller than tarsala I), a microtarsala, and a pretarsala. Leg III coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 3 branched setae; genu with 3 branched setae and a fairly long genuala; tibia with 6 branched setae and a fairly long tibiala; tarsus with about 12 branched setae and 2 mastitarsalae each with a few branches basally. All tarsi terminated by a pair of claws and a more slender clawlike empodium between them.

Body setae: Dorsal setae somewhat like the scutal setae, relatively short (21 to 24 microns) and broad, 90 to 100 in irregular rows, humerals not distinguishable from setae of first row. Ventral setae 2-2 (sternals) plus about 50, those posterior to the anus similar to the dorsal setae.

Type data: Holotype and 4 paratypes, RML No. 31216, from *Dipodomys merriami* (kangaroo rat), Washington County ,Utah, 6 September 1951.

Holotype and 2 paratypes in the collection of the Rocky Mountain Laboratory. One paratype, United States National Museum; one paratype, the British Museum (Natural History).

Other Material:

One specimen from *Perognathus longimembris*, Kane County,

Utah, 8 September 1951, is tentatively referred to this species. It differs slightly from the type series in scutal measurements, and in form of the dorsal setae which number about 80.

Diagnosis: *T. doremi* n. sp. appears to be a distinctive species. The absence of a parasubterminala in combination with the palpal vestiture, the form of dorsal setae, tarsala I longer than tarsala II, and the seeming absence of humerals, should be sufficient to distinguish it from other members of the genus.

Although this species is described as having no parasubterminala, it should be noted that there is a branched seta, as long as the subterminala, which may be homologous to a parasubterminala. This seta, however, is not closely associated with the subterminala as in all other species. It is, therefore, both practical and convenient to regard the species as lacking this specialized seta.

EUSCHÖNGASTIA **FASOLLA** Brennan and Beck, n. sp.

(Fig. 4, A-D)

Body: Length and width of holotype, partially engorged, 300 by 195 microns. Eyes 2/2, the anterior one larger. Anus at about the level of the fifth row of ventral setae.

Gnathosoma: Puncta indicated on cheliceral base, femoral plate of palp and capitular sternum, but not readily discernible in the specimens at hand. Cheliceral blade with tricuspid cap. Seta of capitular sternum with many long branches. Palpal setae as follows: Femoral, very long, densely clothed with long branches; genual, dorsotibial and ventrotibial each with 10 to 12 long branches; laterotibial nude or forked. Palpal tibial claw trifurcate. Palpal tarsus with a tarsala and 7 branched setae. Galeal seta branched.

Scutum: Roughly trapezoidal, about 2 times wider than long, anterior and posterior margins sinuous, as figured, puncta indicated. Sensillary bases posterior to the level of the posterolateral setae and separated by slightly less than the distance from either to its corresponding posterolateral seta. Conspicuous, inverted, U-shaped fold nearly encompassing each sensillary base. Sensillae obcordate-clavate; anterior surface of head covered with large setules, posterior surface covered with coarse setules except a bare median strip; stem bare. Setae thick, plumose, the anterolaterals and posterolaterals nearly equal in length. Scutal measurements of holotype: AW-55, PW-79, SB-25, ASB-28, PSB-11, AP-24, AM-32, AL-50, PL-49, S-34.

Legs: Puncta discernible on some leg segments, indicated on others. Setae as follows: Two kinds of branched setae, the longer ones densely bristled, the shorter ones more or less pectinate. Leg I coxa, trochanter and basifemur each with a branched setae; telofemur with 5 branched setae; genu with 4 branched setae, 2 genualae, and a microgenuala; tibia with 7 branched setae, 2 tibialae (the proximal one pointed, the distal one blunt), and a microtibiala; tarsus with about 18 branched setae, a prominent tarsala, a fairly long microtarsala, and a pretarsala, subterminala and parasubterminala absent. Leg II coxa and trochanter each with a branched seta; basi-

femur with 2 branched setae; telofemur with 4 branched setae; genu with 3 branched setae and a small genuala; tibia with 6 branched setae and 2 tibialae (the proximal one pointed, the distal one blunt); tarsus with about 14 branched setae, a long, slender tarsala, a long microtarsala, and a pretarsala. Leg III coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 3 branched setae; genu with 3 branched setae and a small genuala; tibia with 6 branched setae, no tibiala; tarsus with about 10 branched setae. All tarsi terminated by a pair of claws and a slender clawlike empodium between them.

Body setae: Dorsal setae about 50, similar to the scutal setae, 34 to 41 microns in length. Dorsal formula for holotype: 2-11-10-8-8-6-2-2. Ventral setae 2-2 (sternals) plus about 46, those posterior to the anus similar to the dorsal setae.

Type data: Holotype and 4 paratypes, RML No. 28271, from *Neotoma lepida* (wood rat), Berry Springs, Washington County, Utah, 19 December 1950.

Holotype and 2 paratypes in the collection of the Rocky Mountain Laboratory. One paratype in the United States National Museum, and one paratype in the British Museum (Natural History).

Diagnosis: *E. fasolla* n. sp. is apparently related to *E. radfordi* Brennan and Jones which it superficially resembles. The following characters are similar for both species: Scutal shape and measurements, gnathosomal components, form of body setae, 2 kinds of branched leg setae; and 7 branched setae on tibia I. The former species is distinguished from the latter in lacking subterminala and parasubterminala and in the shape of the sensillae. Also, in *E. fasolla* the specialized leg setae differ somewhat in their proportional lengths.

EUSCHÖNGASTIA **LANCEOLATA** Brennan and Beck, n. sp.

(Fig. 3, A-G)

Body: Ovoidal. Length and width of holotype, slightly engorged, 302 by 220 microns. Eyes 2/2, the anterior one slightly larger. No ocular plate. Anus at level of fifth row of ventral setae.

Gnathosoma: Impunctate. Blade of chelicera with tricuspid cap. Seta of capitular sternum with many long branches. Palpal setae as follows: Femoral heavily branched, genual moderately branched, dorsotibial with 3 to 6 branches, laterotibial with 1 to 3 branches, ventrotibial with 8 to 10 branches. Palpal claw trifurcate. Palpal tarsus with a moderate tarsala and 7 branched setae. Galeal seta strongly branched.

Scutum: Impunctate. Roughly hexagonal, with sinuous posterior margin, as figured. More than 2 times wider than long. Sensillary bases distinctly posterior to level of posterolateral setae and separated by about the distance from either to its corresponding posterolateral seta. An inverted U-shaped fold anterior to each sensillary base. Sensillae pyriform; anterior surface of head sparsely covered with long, slender setules; posterior surface (except for a narrow, bare,

median strip on apical half) with short, coarse setules which on the basal third appear to be 2 to 4-toothed; stem with small setules decreasing in size basally. Setae thick, plumose. Scutal measurements of the holotype: AW-63, PW-88, SB-28, ASB-24, PSB-10, AP-18, AM-31, AL-32, PL-46, S-35.

Legs: Impunctate. Leg I coxa, trochanter and basifemur each with a branched seta; telofemur with 5 branched setae; genu with 4 branched setae, 2 short genualae, and a microgenuala; tibia with 7 branched setae, 2 short tibialae (the distal one slightly thicker and more blunt), and a microtibiala; tarsus with about 18 branched setae, a tarsala, a microtarsala, a subterminala, a parasubterminala, and a pretarsala. Leg II coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 4 branched setae; genu with 3 branched setae and a short genuala; tibia with 6 branched setae and 2 short tibialae, tarsus with about 14 branched setae, a long, slender tarsala, a microtarsala, and a pretarsala. Leg III coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 3 branched setae; genu with 3 branched setae and a short genuala; tibia with 6 branched setae, no tibiala; tarsus with about 12 branched setae. All tarsi terminated by a pair of lateral claws with slender clawlike empodium between.

Body setae: Dorsal setae more than 50, of two forms, several similar to the scutal setae, the majority narrow-lanceolate with short barbs as figured. The setae, similar to the scutal setae, are not constant in number or position, but are always present in the midportion of the first row, sometimes of the second row, and a few may be scattered at random except in the posteriormost rows. All the remaining setae are of the lanceolate form. Dorsal formula of holotype: 2-14-14-11-8-6-2-2. Ventral setae mostly of the usual form, sometimes a few stray setae of the lanceolate form near the margins, 2-2 (sternals) plus about 40, those posterior to the anus similar to the scutal setae.

Type data: Holotype and 11 paratypes, RML No. 28268, from *Peromyscus eremicus* (western desert mouse), Grafton, Washington County, Utah, 17 December 1950; 10 paratypes, No. 28270, same host, county, and state, Berry Springs, 19 December 1950; 1 paratype, from *Neotoma lepida*, same county and state, Rockville, 18 December 1950.

Holotype and some paratypes deposited in the collection of the Rocky Mountain Laboratory. Other paratypes distributed to the United States National Museum, the British Museum (Natural History), the Brigham Young University, the South Australian Museum, the University of Kansas, and Dr. Charles D. Radford.

Diagnosis: The two distinct forms of the dorsal setae in combination with subterminala and parasubterminala, and genuala III will distinguish *E. lanceolata* n. sp. from other members of the genus.

EUSCHÖNGASTIA **LANEI** Brennan and Beck, n. sp.
(Fig. 2, A-D)

Body: Subovate. Length and width of holotype, slightly en-

gorged, 305 by 202 microns. Eyes 2/2, the anterior larger. Anus at about the level of the fifth row of ventral setae.

Gnathosoma: Puncta few, indistinct, but definitely present on cheliceral bases, capitular sternum, and femoral plate of palp. Chelicera blade with tricuspid cap. Setae of capitular sternum with many long branches. Palpal setae: Femoral heavily branched, genual and ventrotibial moderately branched, dorsotibial with few branches, laterotibial nude or with 1 or 2 branches. Claw trifurcate. Palpal tarsus with 6 branched setae and a tarsala. Galeal seta with about 6 strong branches.

Scutum: Puncta few and indistinct. A little more than 2 times wider than long, anterior and posterior margins sinuous, as figured. Sensillary bases at about the level of the posterolateral setae and separated by about the distance from either to its corresponding posterolateral seta. A cuticular fold anterior to each sensillary base. Sensillae obcordate to pyriform; anterior surface of head covered with long setules; posterior surface with short, broad setules except for a bare median strip; setules decreasing in length as they continue part way down the stem. Setae thick, plumose. Scutal measurements of holotype: AW-65, PW-84, SB-29, ASB-19, PSB-13, AP-19, AM-32, AL-30, PL-50, S-29.

Legs: Few indistinct puncta on all segments. Leg I coxa, trochanter and basifemur each with a branched seta; telofemur with 5 branched setae; genu with 5 branched setae, a long genuala, and a microgenuala; tibia with 7 branched setae; 2 subequal tibialae (the distal one more blunt), and a microtibiala; tarsus with about 18 branched setae; a tarsala, a microtarsala, a subterminala, a parasubterminala, and a pretarsala. Leg II coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 4 branched setae; genu with 3 branched setae and a small genuala; tibia with 6 branched setae and 2 small tibialae; tarsus with about 14 branched setae, a long, slender tarsala, a microtrsala, and a pretarsala. Leg III coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 3 branched setae; genu with 3 branched setae and a very short genuala; tibia with 6 branched setae, no tibiala; tarsus with about 14 branched setae. All tarsi terminated by a pair of lateral claws with a longer clawlike empodium between.

Body setae: Dorsal setae similar to the scutal setae, 28 to 42 microns long, decreasing in length from anterior to posterior rows. Dorsal formula for the holotype: 2-13-14-11-8-4-2. Ventral setae 2-2 (sternals) plus about 46, those posterior to the anus similar to the dorsal setae.

Type data: Holotype and 9 paratypes, RML No. 31172, from *Reithrodontomys megalotis* (desert harvest mouse), Lucin, Box Elder County, Utah, 10 October 1952; 20 paratypes, Nos. 31176, 31183, 31184, from *Peromyscus maniculatus*, same location, 10 and 11 October 1952; 5 paratypes, No. 31188, *P. maniculatus*, Jensen, Uintah County, Utah, 8 November 1952.

Holotype and some paratypes deposited in the collection of the Rocky Mountain Laboratory. Other paratypes distributed to the Brigham Young University, the United States National Museum, the British Museum (Natural History), the South Australian Museum, the University of Kansas, and Dr. Charles D. Radford.

Diagnosis: *E. lanei* is distinguished from *E. criceticola* Brennan by the presence of puncta and only 1 genula I.

This species is named for a friend, Paul R. Lane, Evanston, Illinois.

EUSCHÖNGASTIA **OBESA** Brennan and Beck, n. sp.

(Fig. 2, E-H)

Body: Broad ellipsoidal to subquadrate when engorged. Length and width of holotype, engorged, 680 by 525 microns. Eyes 2/2, sub-equal. Anus at about the level of the fifth row of ventral setae.

Gnathosoma: Cheliceral bases, capitular sternum, and femoral plate of palp lightly punctate. Cheliceral blade with tricuspid cap. Setae of capitular sternum with many long branches. Palpal setae: Femoral heavily branched, genual moderately branched, dorsotibial with 6 to 8 branches, laterotibial with 1 or 2 branches, ventrotibial moderately branched. Palpal claw trifurcate. Palpal tarsus with 7 branched setae and a conspicuous tarsala. Galeal seta with about 8 branches.

Scutum: Roughly hexagonal, a little more than 2 times wider than long, puncta few and indistinct. Sensillary bases posterior to the level of the posterolateral setae and separated by considerably more than the distance from either to its corresponding posterolateral seta. A cuticular fold anterior to each sensillary base. Sensillae pyriform; the anterior surface of the head with long setules; the posterior surface with shorter, coarse setules and a bare median strip; setules decrease in size part way down the stem, basal portion of stem bare. Setae thick, densely clothed with semi-appressed barbs. Scutal measurements of holotype: AW-84, PW-110, SB-44, ASB-29, PSB-18, AP-20, AM-39, AL-38, PL-57, S-39.

Legs: All segments with few puncta, not easily discerned on all specimens. Leg I coxa, trochanter and basifemur each with a branched seta; telofemur with 5 branched setae; genu with 4 branched setae, 2 long genualae, and a microgenuala; tibia with 7 branched setae, 2 moderately long tibialae (the distal one more blunt), and a microtibiala; tarsus with about 18 branched setae, a thick and relativenly short tarsala, a microtarsala, a subterminala, a parasubterminala, and a pretarsala. Leg II coxa and trochanter each with a branched set; basifemur with 2 branched setae; telofemur with 4 branched setae; genu with 3 branched setae and a genuala; tibia with 6 branched setae and 2 short tibialae; tarsus with about 14 branched setae, a long, slender tarsala, a microtarsala, and a pretarsala. Leg III coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 3 branched setae; genu with 3 branched setae and a short genuala; tibia with 6 branched

setae, no tibiala; tarsus with about 14 branched setae. All tarsi terminated by a pair of claws and a longer clawlike empodium between them.

Body setae: Dorsal setae similar to the scutal setae but barbs not so appressed; 38 to 54 microns long, decreasing in length from anterior to posterior rows. Dorsal formula for the holotype: 2-12-12-12-8-6-4-2. Ventral setae 2-2 (sternals) plus about 50, those posterior to the anus similar to the dorsal setae.

Type data: Holotype and 9 paratypes, RML No. 31212, from *Peromyscus maniculatus* (a white-footed mouse), Torrey, Wayne County, Utah, 7 August 1952; 10 paratypes, No. 31173, same data; 20 paratypes, Nos. 31175, 31182, and 31192, same host, Cedar Valley, Utah County, Utah, 1 November 1952.

Holotype and some paratypes deposited in the collection of the Rocky Mountain Laboratory. Other paratypes distributed to the Brigham Young University, the United States National Museum, the British Museum (Natural History), the South Australian Museum, the University of Kansas, and Dr. Charles D. Radford.

Other material referred to this species: Four specimens (having fewer dorsal setae) off *Cynomys leucurus*, Duchesne County, Utah, 21 August 1952. One specimen off *Perognathus formosus*, Fish Springs, Utah, 14 July 1951.

Diagnosis: *E. obesa* n. sp. is closely related to *E. criceticola* Brennan from which it differs principally in the presence of puncta, and in its different shape and larger size when engorged.

EUSCHÖNGASTIA **ROTUNDA** Brennan and Beck, n. sp.

(Fig. 2, I-L)

Body: Nearly spherical when engorged. Holotype, engorged, 650 by 567 microns. Eyes 2/2. Anus at about the level of the fifth row of ventral setae.

Gnathosoma: Cheliceral bases, capitular sternum and femoral plate of palp punctate. Blade of chelicera with tricuspid cap. All palpal setae, except the nude laterotibial, heavily to moderately branched. Palpal claw trifurcate. Palpal tarsus with 7 branched setae and a fairly long tarsala. Galeal seta strongly branched.

Scutum: Roughly hexagonal, about 3 times wider than long, puncta few and inconspicuous. Sensillary bases posterior to the level of posterolateral setae and separated by the distance from either to its corresponding posterolateral seta. An indistinct fold anterior to each sensillary base. Sensillae pyriform; anterior surface of head covered with long setules, posterior surface with coarse, shorter setules, sparsely distributed in mid-apical region; stems bare. Setae thick, plumose. Scutal measurements of holotype: AW-91, PW-124, SB-42, ASB-36, PSB-16, AP-24, AM-38, AL-37, PL-67, S-39.

Legs: All segments punctate. Leg I coxa, trochanter and basifemur each with a branched seta; telofemur with 5 branched setae; genu with 4 branched setae, 2 long genualae, and a microgenuala;

tibia with 7 branched setae, 2 long, nearly identical tibialae and a rather long microtibiala; tarsus with about 20 branched setae, a prominent tarsala and a microtarsala, a subterminala and parasubterminala, and a pretarsala. Leg II coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 4 branched setae; genu with 3 branched setae and a long genuala; tibia with 6 branched setae and 2 long tibialae; tarsus with about 16 branched setae, a tarsala (a little longer than tarsala I), a microtarsala, and a pretarsala. Leg III coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 3 branched setae; genu with 3 branched setae and a fairly long genuala; tibia with 6 branched setae, no tibiala; tarsus with about 14 branched setae. All tarsi terminated by a pair of claws with a slender clawlike empodium between.

Body setae: Dorsal setae about 80, 40 to 55 microns long, similar to the scutal setae in form, in irregular rows. Humerals, 2 pairs. Ventral setae 2-2 (sternals) plus about 60, those posterior to the anus similar to the dorsal setae.

Type data: Holotype and 9 paratypes, RML No. 31174, from *Ochotona princeps* (pika, cony), Geyser Pass, San Juan County, Utah, 1 July 1952.

Holotype and some paratypes in the collection of the Rocky Mountain Laboratory. Other paratypes in the United States National Museum, the British Museum (Natural History), the South Australian Museum, and the University of Kansas.

Diagnosis: *E. rotunda* n. sp. is related to *E. criceticola* Brennan from which it is separated by the presence of puncta, its subspherical form when engorged, 2 pairs of humeral setae, greater number of and irregular arrangement of dorsal setae, and larger specialized leg setae and their different proportional lengths.

EUSCHÖNGASTIA **UTAHENSIS** Brennan and Beck, n. sp.

(Fig. 4, E-H)

Body: Subellipsoidal. Length and width of holotype, nearly engorged, 443 by 258 microns. Eyes of moderate size, 2/2, no plate. Anus at level of about fifth row of ventral setae.

Gnathosoma: Cheliceral bases, capitular sternum, and femoral plate of palp punctate. Cheliceral blade with tricuspid cap. Setae of capitular sternum with several long branches. Palpal setae as follows: Femoral with about 6 branches, genual with about 4 branches, dorsotibial with 2 or 3 branches, laterotibial nude or forked, ventrotibial with 2 or 3 branches. Palpal tibial claw trifurcate. Palpal tarsus with a small tarsala and 5 branched setae. Galeal seta nude.

Scutum: Roughly trapezoidal. Few puncta. Little more than 1½ times wider than long. Sensillary bases anterior to level of posterolateral setae and separated by about the distance from either to its corresponding posterolateral seta. A fold anterior to each sensillary base. Sensillae oblanceolate-clavate; the head with few long setules, evenly distributed on the anterior surface, but absent from

median area of posterior surface; setules progressively decrease in length as they continue somewhat more than halfway down the stem. Setae with semi-appressed barbs. Scutal measurements of holotype: AW-50, PW-66, SB-23, ASB-20, PSB-15, AP-29, AM-26, AL-20, PL-33, S-37.

Legs: All segments with puncta. Leg I coxa trochanter, and basifemur each with a branched seta; telofemur with 5 branched setae; genu with 4 branched setae, 2 long genualae, and a microgenuala; tibia with 8 branched setae, 2 tibialae (the distal one thick and blunt, the proximal one thinner and pointed), and a microtibiala; tarsus with about 18 branched setae, a tarsala, a microtarsala, a subterminala, a parasubterminala, and a pretarsala. Leg II coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 4 branched setae; genu with 3 branched setae and no genuala; tibia with 6 branched setae and 2 small tibialae; tarsus with about 14 branched setae, a slender tarsala, a microtarsala, and a pretarsala. Leg III coxa and trochanter each with a branched seta; basifemur with 2 branched setae; telofemur with 3 branched setae; genu with 3 branched setae and no genuala; tibia with 6 branched setae and a tibiala; tarsus with about 10 branched setae. All tarsi terminated by a pair of claws with a more slender clawlike empodium between them.

Body setae: Dorsal setae similar to the scutal setae, 22 to 30 microns in length. Dorsal formula: 2-8-6-6-6-2-2. Ventral setae 2-2 (sternals) plus about 26, those posterior to the anus similar to the dorsal setae.

Type data: Holotype and 3 paratypes, RML No. 30161, from *Neotoma lepida* (wood rat), Fish Springs, Juab County, Utah, 14 July 1951.

Holotype and a paratype in the collection of the Rocky Mountain Laboratory. One paratype in the United States National Museum and one in the British Museum (Natural History).

Diagnosis: *E. utahensis* n. sp. is suggestive of *E. lacerta* Brennan but differs in the dorsal formula, and in having a subterminala and a parasubterminala, and 2 genualae I (1 genuala I in the latter).

SUMMARY

In this first report on the chiggers of Utah, 38 species, of which 8 are described as new, are recorded. The new species, all from rodents are: *Trombicula allredi*, *T. doremi*, *Euschöngastia fasolla*, *E. lanceolata*, *E. lanei*, *E. obesa*, *E. rotunda*, *and E. utahensis*.

A key and collecting data are given for the species included.

Acomatacarus sexacis Allred and Beck is synonymized under *A. micheneri* Greenberg, and *Trombicula imperfecta* Brennan and Jones under *T. hoplai* Loomis.

Trombicula potosina Hoffman, a Mexican species, is recorded for the first time in the United States.

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ADDENDUM

The publication by Gould of the paper cited above as in press and the discovery of another species in Utah too late for inclusion in the key necessitate these further notes.

The complete Gould reference:

Gould, D. J. The larval trombiculid mites of California (Acarina: Trombiculidae). Univ. Calif. Publs. Ent. 11 (1): 1-116. 1956.

Species listed by code in key and text:

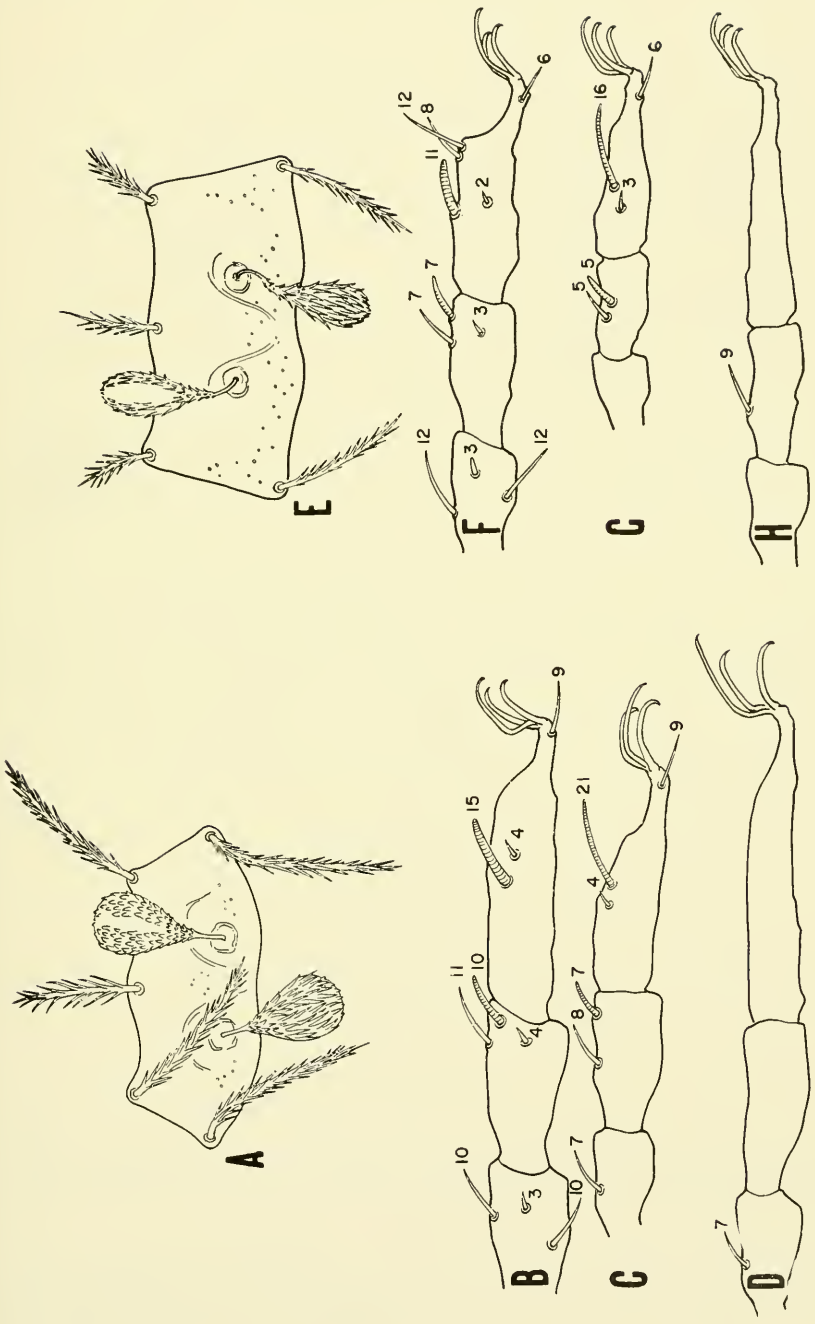
Euschöngastia decipiens Gould 1956, p. 61, *Euschöngastia* "d" n.sp. and *Euschöngastia hoffmannae* Gould. 1956, p. 52 for *Euschöngastia* "h" n.sp.

The additional and thirty-ninth species recorded from Utah:

Euschöngastia furmani Gould, 1956, p. 63, WASHINGTON COUNTY: From *Neotoma lepida*, 26 November 1955, 7 specimens identified (RML).

In the key, this species runs to *Euschöngastia hoffmannae* ("h" n.sp.) from which it is easily distinguished by 2 pairs of humeral setae, and punctate scutum, cheliceral bases and legs.

Fig. 1, A-D. *Trombicula doremi*, n.sp. A. Scutum. B-D. Specialized setae of legs I to III, proportional lengths indicated. E-H. *Trombicula allredi*, n.sp. E. Scutum. F-H. Specialized setae of legs I to III, proportional lengths indicated.


A
B
C
D
E
F
G
H

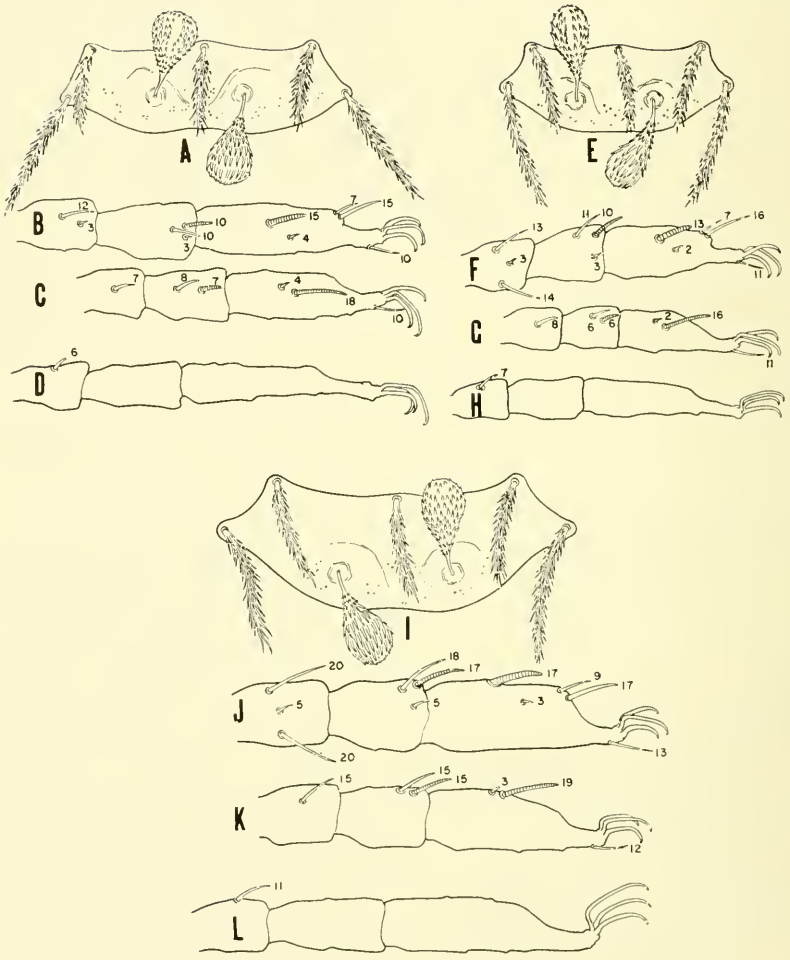


Fig. 2. Scutum and specialized setae of legs I to III, small figures indicating proportional lengths. A-D. *Euschöngastia lanei*, n.sp. E-H. *Euschöngastia obesa*, n. sp. I-L. *Euschöngastia rotunda*, n.sp.

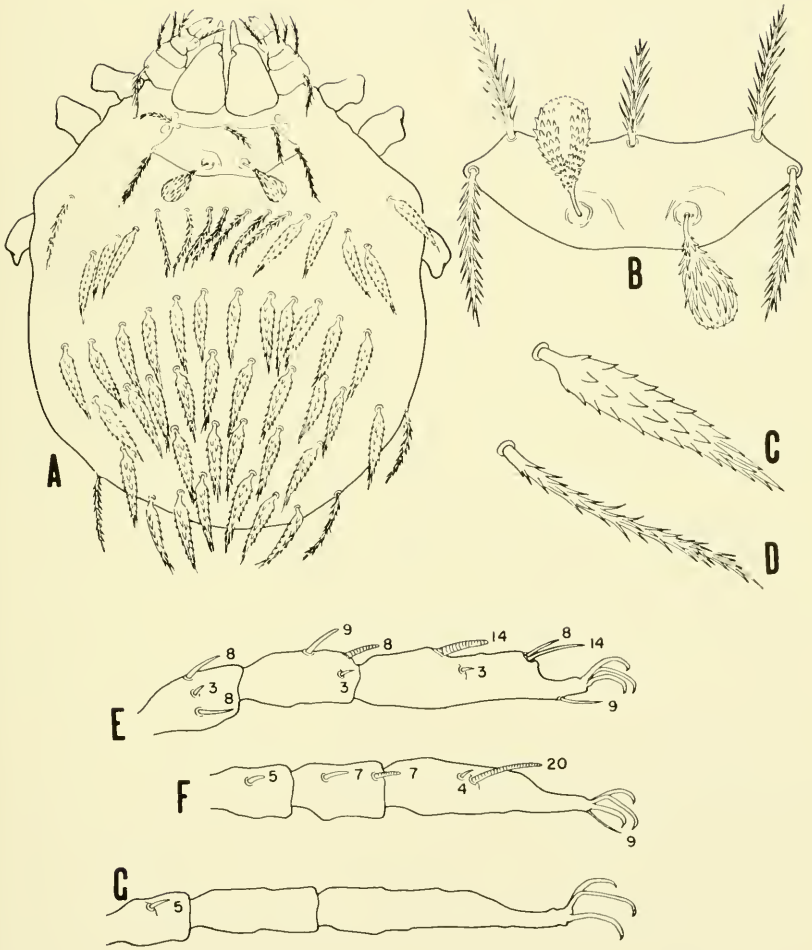


Fig. 3. *Euschöngastia lanceolata*, n.sp. A. Dorsum. B. Scutum; posterior surface of sensilla, left, anterior surface, right. C. Dorsal seta, lanceolate form. D. Dorsal seta, scutal setal form. E-G. Specialized setae of legs I to III, proportional lengths indicated.

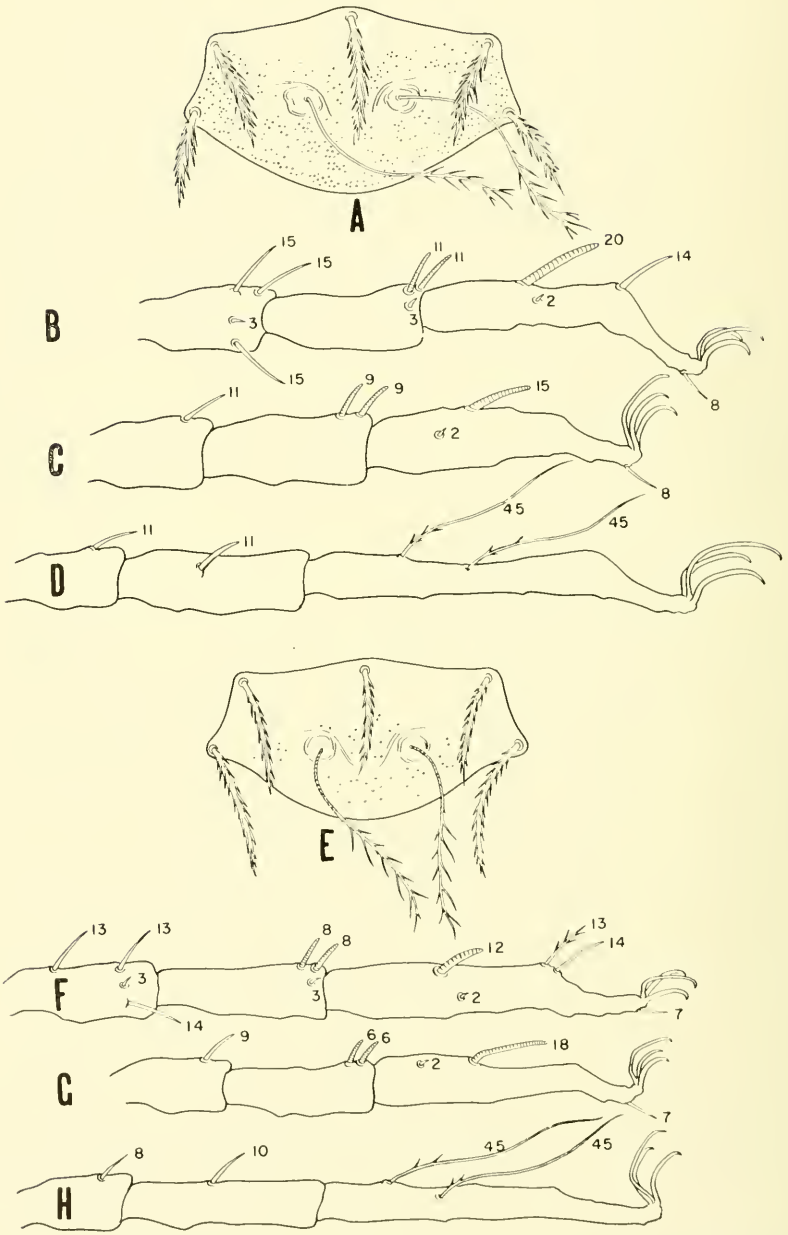


Fig. 4. Scutum and specialized leg setae of legs I to III, figures show proportional lengths. A-D. *Euschöngastia fasolla*, n.sp. E-H. *Euschöngastia utahensis*, n.sp.

THE AMPHIBIA OF GREER COUNTY, OKLAHOMA[1]

ARTHUR N. BRAGG[2]

Greer County, Oklahoma, lies not quite in the southwestern corner of the state. It is bounded on the north by Beckham, on the east by Kiowa, on the south by Jackson, and on the west by Harmon counties. It is drained by three major streams: (1) the North Fork of the Red River which separates it from Kiowa County all along its eastern edge, (2) the Elm Fork which cuts diagonally southeastward through its center to enter the North Fork, and (3) the Salt Fork of the Red River which flows eastward and then southward in the southern portions of the county.

Greer is essentially one of the prairie counties of Oklahoma. Probably originally mixed grassland is it now largely short grass prairie. However, in its western and northwestern portions considerable areas of gypsum rock come to the surface and this in some places has caused a rugged relief and a change in vegetation locally as differential erosion has occurred. Similarly, along its eastern border, great granitic masses known as the Granite Mountains occur as largely bare and steep rock up-thrusts from the surrounding plain. These are the western outliers of the Wichita Mountains. In many places in the grassland areas, especially in flat lands along small creeks, smaller or largest stands of mesquite dominate or partially dominate the landscape. Some such stands of mesquite savannah are very extensive like the one in which I once lost my direction and floundered around for an hour or more before wandering onto a section line road running through it and thus finding my way out.

This area of Oklahoma has deficient rainfall, high winds, and high temperatures. The evaporation rate from all water surfaces is very rapid, especially during summer. Fast development is a necessity for any amphibian here that uses temporary pools for breeding, as most of them do. Only one salamander occurs in this region so far as known and no others are expected. The remainder of the Amphibia are Salientia.

1. *Ambystoma tigrinum morvortium* Baird

This "prairie edition" of the tiger salamander is very abundant in all parts of the county. It is a nocturnal, burrowing form whose adults are rarely seen except after rains. Spring and summer rains apparently stimulate breeding—at least, the adults enter the water for breeding at such times only, so far as I can determine. They breed in temporary water (ditches particularly) farther north in western Oklahoma but in Greer County I have found their larvae only in the cattle tanks, some of which here are quite deep (6-12 feet or more) when full. In deep tanks, the larvae will be found only in the deeper (and therefore cooler) water on very hot days.

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1. Contribution of the Department of Zoology and of the Biological Survey, University of Oklahoma, Norman.

2. Professor of Zoology and Herpetologist of the Biological Survey, University of Oklahoma.

In tanks in the gypsum regions, the larvae are very light colored, light cream all over except the tail tip which is intensely black and the gill bars which are bright golden. In waters off the gypsum they are a nondescript greenish-brown; lighter in turbid than in clear water, but never like those on the gypsum.

If one traverse the whole county in June, sampling many tanks, he is struck by the different sized larvae commonly found. In one tank they may be tiny, in another half grown, in still a third intermediate in size. However, within any one region adjacent tanks tend to have larvae of comparable sizes and in a single tank it is rare to find more than two size groups, - usually only one. This phenomenon is associated with rainfall pattern and reflects the dependency of breeding adults upon rainfall for their breeding activities. This is more striking in some years than in others, of course, but so clear cut that during most years one could, by sampling pools for larval sizes, draw a fairly accurate pattern of the rainfall over the county a month or two before. In some years larvae are rare: in others, abundant.

I have not seen their metamorphosis in this region. It sometimes, at least, occurs in July in some other parts of western Oklahoma, north of Greer County.

2. *Acris crepitans* Baird.

Common on muddy banks of pools everywhere, breeding in the adjacent waters. Calling begins usually in April and is intermitant all summer. Most breeding is after the spring rains.

3. *Bufo cognatus* Say.

Very abundant breeding after rains only, in temporary pools.

4. *Bufo compactilis speciosus* Baird.

This is the most abundant toad in this region, breeding after rains in temporary pools, but also in the edges of cattle tanks and in pools along the rivers. This toad and *Bufo cognatus* occur together in all parts of the country. *Bufo compactilis speciosus* tends to be the more abundant on the higher land between stream valleys.

5. *Bufo debelis debelis* Girard.

Following the nomenclature of Sanders and Smith (1951), this is the form to be found here. It is present throughout the county but in small numbers only. It is most abundant on mesquite flats and is unknown immediately near the larger streams. Like the other prairie toads it breeds after rains only and in temporary pools. It must have a very rapid development to exist using so shallow water. That it does so is evidenced also by my consistent misjudging when to return to the site of a breeding congress in an attempt to get its tadpoles, which, until recently, I have been unable to see. I have never seen its eggs which are still undescribed.

6. *Bufo punctatus* Baird and Girard.

This little toad of the rocky and rough regions of Oklahoma is known in Greer County from only one specimen collected in early morning after a rain in the night at the foot of one of the Granite

Mountains. Since it occurs in the prairies in Beckham County to the north (Bragg and Dundee, 1950) and is generally found in gypsum country in western Oklahoma, it presumably occurs sparingly over much of Greer County.

7. *Bufo woodhousei woodhousei* Girard.

This is the abundant toad of lawns and gardens and under streetlights in towns in Greer County. It is also the dominant toad along the streams but it occurs also in prairies and mesquite flats. It is, however, rarer on the higher areas between the streams. It breeds in both temporary and permanent waters and, whereas rain greatly stimulates its breeding, it is not a necessity to it. Mixed breeding congresses of this toad with *Bufo cognatus*, *Bufo compactilis speciosus*, and *Bufo debelis debelis* and members of other genera are the rule rather than the exception after rains in spring and early summer.

8. *Microphyla caroliensis olivacea* (Hallowell).

Abundant everywhere, breeding in rain-formed pools, immediately after rains from late April on through summer. Embryos and tadpoles have a very rapid development but this has not yet been accurately measured.

9. *Pseudacris clarki* Baird.

Very abundant in prairie, breeding in temporary, shallow, well-vegetated pools after rains.

10. *Pseudacris nigrita triseriata* (Wied). (?)

I once found tadpoles in a tank in Greer County which I identified at that time as of this form. Later I ran these down to this subspecies in testing a key (Bragg, 1950) then in preparation. However, I doubt my own record now on ecological grounds and recommend waiting until someone succeeds in finding adults here before definitely placing them in the list of Greer County forms.

11. *Rana catesbeiana* Shaw.

Very common in the larger tanks.

12. *Rana pipiens berlandieri* Baird.

13. *Rana pipiens brachycephala* Cope.

Leopard frogs are very abundant about water everywhere. Some are certainly *R. p. brachycephala*. Further observations are needed in these frogs here as well as elsewhere.

14. *Scaphiopus couchi* Baird.

The southern spadefoot is very abundant in all parts of Greer County. It is common on the roads on summer nights and is sometimes found under streetlights with Bufo. It breeds after rains in shallow temporary pools. The exact time relations of its tadpole stages are not known, but I have many indications that the development is very rapid. I have several times failed to find tadpoles two and a half to three weeks after a known breeding congress had produced eggs.

15. *Scaphiopus bombifrons* Cope.

16. *S. hammondi* Baird.

The former of these two is abundant in all parts of Greer County but the latter is rather questionably present. I reported it from tadpoles collected in the gypsum region of the northwestern part of the county (Bragg, 1948), recognizing its tadpoles by the characteristic mouth parts (Smith, 1934; Bragg, 1941). However, Stebbins (1951) has cast doubt on the validity of the beak-notch relationship of the mandibles, having found many intermediate conditions in the western United States. I can confirm him in his facts. In western Oklahoma, including Greer County as well as several others, tadpoles with various intermediate conditions of beak-notch relation have been found. I have known such specimens from the Oklahoma Panhandle for at least twelve years. However, I have always found such specimens within the habitat of *S. bombifrons* when *S. hammondi* were also present: where *S. bombifrons* occurs alone, as in central Oklahoma, none have ever been found with any marked degree of the beak-notch character. Accordingly, I have interpreted the facts to indicate interbreeding between these two in areas where *S. hammondi* is present in small numbers only, the bulk of the population as in Greer County being *S. bombifrons* (Bragg, 1946). The fact that some of the tadpoles studied to the west of Oklahoma may have come from regions where *S. bombifrons* does not occur gives considerable weight to the interpretation of Stebbins as opposed to my own. I do not think the problem settled, however. More observations are needed.

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A NEW *SCELOPORUS MAGISTER* FROM EASTERN UTAH[1]

WILMER W. TANNER

The analysis of the Desert Scaly Lizard, *Sceloporus magister* Hallowell, by Phelan and Brattstrom (1955), did not include a study of the populations of this species from the Upper Colorado River Basin of southeastern Utah. With a large series of this species available from Kane, Garfield, and Emery Counties, and with comparative material from Washington County, Utah, eastern Nevada, and California, it is apparent that the Upper Colorado River Basin populations represent a subspecies distinct from the populations of the southwest deserts.

SCELOPORUS MAGISTER **CEPHALOFLAVUS** W. W. Tanner, subsp. nov.[2]

HOLOTYPE: (An adult male) BYU 11270, collected at Bentley's Cabin, approximately 15 miles NW of Hole-in-the-Rock, Kaiparowits Plateau, Kane County, by D. Elden Beck, 16 July, 1953.

PARATYPES: All numbers are from the Brigham Young University Collection. *Emery County*. - Green River, 531, 1780-1, 12445. *Wayne County*. - Notum, 11903. *Garfield County*. - Star Springs, Mt. Hillers, 12620, 13151, 13174; 20 miles NW of Hite (North Wash) 13153-66, 13174; two miles S. of Trachyte Creek 13167-72; Hog Springs, 14 miles NW of Hite, 12712-4, 12680-3. *Kane County*. - Hole-in-the-Rock, 11400, 11263-4, 12885-6; Lone Rock, 11399, 12007, 13143-4, 13067; Catstair Canyon, 11392-8, 12845; Escalante River, lower portion, 9769, 11390; Coyote Gulch, 12947; Hall Cave, 123, 929-37; Willow Tank Spring, 115, 119, 901-5, 912-16, 4183-4, 11392-7; Wahweap Creek, upper portion, 2744, 2126-7, 2134-5.

DIAGNOSIS: A *Sceloporus magister* characterized by the presence of five or six chevron shaped bars, 1½ to 2½ scales wide, on the dorsum from the shoulders to the base of the tail, in most adult males. Dorsal head plates and nape ranging from Apricot Yellow to Orange Chrome, Ridgeway (1912) in adults (male & female). Eye stripe extended to ear or beyond, and with a second stripe extending from the corner of the mouth to the base of ear. Infralabials 6-8, usually 7-7; scales across the gular area 18-21, average 19.2.

DESCRIPTION OF THE TYPE: Total length 222 mm., snout to vent 104.5 mm.; dorsal scales 36, ventral scales 35, scale rows around the body 34; femoral pores 12-12; gular scales between ears 19;

1. Contribution No. 149, Department of Zoology and Entomology.
2. The new name has reference to the yellow of the dorsal head plates and the nape in adults.

supralabials 5-5, infralabials 7-8, enlarged auricular lobules 4-4; lamellae of fourth hind toe 17-17.

COLORATION (in alcohol): Ground color approximately a Buffy-Brown on body and head, nape a cream color, venter and throat black, chest and anal region Cartridge Buff; eye stripe distinct and extended three scales beyond top of ear, labial stripe from corner of mouth to base of ear; nape with two longitudinal stripes, approximately 1½ scales wide and extending for a length of 5 scales; gular patch joined to first chevron forming a collar 2½ scales wide at the dorsum; body with 5 chevrons, last two faint. Four lateral spots on each side, anterior ones faintly joined to chevrons; black on ventral surface of thigh approximates 60 per cent from inner margin of femoral pores to knee, black of belly extensive and united for 85 per cent of the area.

RANGE: Paria River drainage of central Kane County east to the Colorado River and north through eastern Garfield, Wayne, and Emery Counties, Utah. A small series from San Juan County approaches *cephaloflavus* closely as do those seen from Cameron, Coconino County, Arizona.

VARIATIONS: Although the basic body pattern of *cephaloflavus* consists of chevron shaped bars across the dorsum, this pattern is occasionally modified into a series of irregular spots, at times approaching the basic pattern of *bimaculosus*. The occasional spotted condition observed by Phelan and Brattstrom (*loc. cit.*) in *uniformis* of eastern Nevada and southwestern Utah represents intergradation between the latter and *cephaloflavus*. A series of adult males from the latter localities (see material) shows the chevron in three, spots in thirteen, and the uniform dorsum in four. Aside from the modifications in the basic patterns the most striking color variations, between *uniformis* (including the *uniformis x cephaloflavus* intergrades of southwestern Utah and adjoining Nevada) and typical *cephaloflavus* is the yellowish-orange color in the latter. Adult males from California *(uniformis)* show a distinct series of four or five lateral spots separated by 1-2 scales. In *cephaloflavus* these spots are close together, often with two or three joined by one or more scales, and thus forming in some specimens an irregular lateral stripe. The belly patches, although varying as to the amount, are united in 78 per cent of the males studied.

Scutellation differences, though small, do exist in the increased gulars between the ears 18-21, average 19.2; and in the increased infralabials 6-8, average 7.05. Other scale counts are as follows: scale rows around body, 33-40, average 36.3; dorsals 31-36, average 33.6; ventrals 34-41, average 38.2; femoral pores 10-15, average 12.6; lamellae of fourth hind toe 15-18, average 16.4. The circumorbitals are variable ranging from 3 to 8, whereas the supralabials are constantly 5, rarely showing 4 or 6.

COMPARATIVE MATERIAL: All numbers are from the Brigham Young University Collection: - ARIZONA, *Coconino County*. -

Cameron, 13152; between Tuba City and Lee's Ferry, 639. *Graham County*: Ft. Thomas. 10267-71. CALIFORNIA, *Los Angeles County*. - 2 miles E of Littlerock, 13175; 3 miles E of Llano, 13176. *San Benito County*. - Panoche Valley, 8848. *San Bernardino County*. - Cajon Pass, 11847. NEVADA. *Clark County*. - Horseshoe Island, Lake Meade. 2945, 3666-69. *Lincoln County*. - 16 miles W of Caliente, 9795-97, 9850; Crystal Springs, 10182-85. UTAH, *San Juan County*. - Bluff, 530, 1584, 1777-9; Montezuma Creek, 13177-9. *Washington County* - Cactus Flats, SW of Castle Rock. 2734, 3739, 8757; St. George, 495, 514, 1514, 1516, 1519, 8785, 10345, 11851, 1561-3, 1569-70, 1572, 1579, 1792-4; Berry Springs, 9718, 9772; Zion Nat'l. Park, 496, 1771-6, 3787, 11391.

Remarks: Insufficient material, from southeastern Utah and adjoining Arizona, Colorado and New Mexico, limits our understanding of the relationships of *cephaloflavus* and *bimaculosus*. It is apparent, however, that *cephaloflavus* is closely related to *uniformis* with which it is known to intergrade over a wide area in eastern Nevada and southwestern Utah.

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A STUDY OF THE ASPECTIONAL VARIATIONS OF SIPHONAPTERA ASSOCIATED WITH THE NESTS OF THE THOMAS WOOD RAT *NEOTOMA LEPIDA LEPIDA* THOMAS[1]

J. FRANKLIN HOWELL

INTRODUCTION

The purpose of this study was to determine seasonal variations in flea populations associated with the nests of the desert wood rat *Neotoma lepida lepida* Thomas.

Faunal nest surveys are becoming increasingly important in connection with the ecology of mammalian parasites. Nest consort studies, not of seasonal nature, have been conducted in California, Oregon, and Utah concerning three species belonging to the genus *Neotoma*. Nevertheless, these nest studies were not on a yearly basis so as to show differences as analyzed from a seasonal aspect.

In addition to providing further information in the field of general flea ecology, there is the importance of such a study as it is related to plague ecology (disease-host relationships). Eskey and Haas (1939) reported the desert wood rat *(N. l. lepida)* as being plague implicated and it is known that plague implicated fleas inhabit the nest of *N. l. lepida* (Beck, Barnum, and Moore, 1953). Nothing is known about the population changes of these flease as demonstrated on a seasonal basis. This paper is presented to indicate what changes were noted from an aspectional point of view.

REVIEW OF LITERATURE

Siphonapterists have long known that flea consortes are found in the nests and on the bodies of host animals. Holland (1949) explains:

> "The number of adult fleas that may be removed from an animal is not necessarily indicative of the number belonging to it, as by far the greater proportion of them is frequently to be found in the nest. Some species rarely leave the nests at all."

Bishopp (1915) was one of the first to publish information relative to such flea associations. Rothschild and Clay (1952) in their study of bird fleas have found that certain species of fleas are associated with the nest rather than the host. The above authors give some aspectional differences related to flea populations.

With the advent of sylvatic plague surveys it became apparent that it was important to recognize the ecological factors related to the hosts and their flea consortes. Stewart and Evans (1941) have shown in their study of rodents and their burrows that there was a definite variation in populations of fleas as seen on an aspectional basis. Other workers, such as Holdenried, Evans, and Longanecker (1951),

1. A Thesis presented to the department of Zoology and Entomology in partial fulfillment of requirements for the degree of Master of Science, Brigham Young University, Provo, Utah. Contribution from this Department, Number 148.

Longanecker and Burroughs (1952), and Burroughs (1947) have contributed information on the ecology of host-parasite relationships which includes some data relative to aspectional differences.

Eskey and Haas (1939) demonstrated that plague can be carried by wild rodent fleas and have listed many rodent fleas which may be implicated in plague epizootics. Meyer and Holdenried (1949) substantiated that transmission of plague may occur in nature. These men through their work have emphasized the importance and necessity of further ecological data concerning rodents and their parasites with regard to seasonal differences.

In his life history study of *Neotoma fuscipes* Rhoades, Vestal (1938) emphasizes the importance of nest and host consortes in connection with the ecology of the host. Walters and Roth (1950) worked out a faunal study of the nests of *Neotoma fuscipes monochroura* Rhoades in Oregon. Traub and Hoff (1951) considered the wood rat nests of prime importance in their distributional studies of fleas in New Mexico. Holland (1949) believes there is an indication that the nests serve as incubators of ectoparasites especially in arid regions. Thus the ecology of the nests of rodents is becoming increasingly important to the zoologist from a public health point of view.

DESCRIPTION OF AREA

The study area of approximately three square miles, lies three miles northeast of Jericho, Juab County, Utah, paralleling highway U.S. 6. The area has an average elevation of 5,200 feet above sea level. Physiographically the country is a rolling landscape with alternating low ridges and small valleys. The soil composition is of general sierozem and desert types (Odum, 1953). Scattered igneous and limestone rocks are characteristic of the area.

The predominant plants are the Utah juniper, *Juniperus utahensis* (Engelm.), sagebrush, *Artemisia tridentata* Nutt., and rabbitbrush, *Chrysothamus* sp. The junipers are characteristic of the low ridges while sagebrush and rabbit brush are usually confined to the valley flats. Many other shrubs and grasses occur throughout the area but are not in great abundance (Fig. 1).

NESTING HABITS

The life history and habits of some species of *Neotoma* have been worked out previously by Goldman (1910) and Richardson (1924). Others, such as Vestal (1938), have added much to the understanding of the life history of individual species. No attempt will be made in this study to give an extended discussion of the habits of *N. lepida*. Nevertheless, some important observations have been recorded and are described in brief below.

According to Richardson (1924), immdiately upon weaning the rat constructs a house.* The house is built from any available materials within the immediate environs. The house of *N. lepida* is

*The use of the term "house" follows the designation as applied by Vestal (1938).

made up of about 95 per cent sticks of various size, primarily juniper sticks, but thorny vegetation, bits of cactus, bones, stones, leaves, and almost anything else they can carry may be used.

An occupied house may be recognized at a glance, owing to its well kept appearance and the presence of slight repairs and additions (Goldman, 1910). Vestal (1938) in his study on *N. fuscipes* states that the rat continually adds to its house throughout the year. During the October collections in the present study it was observed that several of the houses exhibited a complete new layer of material deposited on the exterior of the house. Apparently building activity increases in preparation for the winter months.

The house, depending upon age, will vary in size from two feet in diameter and six inches in depth to seven feet in diameter and five feet in depth. The house in some way is usually associated with a juniper tree. The tree aids construction, provides protection, and is a source of food (Fig. 2).

Houses have from one to a half dozen entrances to burrows which run both above and below the surface of the ground (Fig. 3). Often during summer months, the nest may be seen from one of these entrances. To reach a nest all outer construction as described above must first be removed. An effort was made to collect only nests from houses which displayed habitance.

The term "nest" refers only to the finer materials forming the actual bed for the animal (Vestal, 1938). It is typically an oval pocket recessed into the wall or floor of the nest chamber (Fig. 3). Usually it is constructed of shredded bark but whenever possible fur, hair, and other soft material is used. In the laboratory a captive rat readily substituted cotton in preference to bark. As to size, a teacup will easily fit into the cavity of the usual nest.

Vestal (1938) indicates the presence of one or more chambers in the house of *N. fuscipes*. Observations made during this study indicate the presence of only one chamber in the house of *N. lepida;* the nest chamber. A few houses contained two nests but the consortes extracted indicated that only one nest was in regular use. Often each of the two nests were in separate chambers but it seems apparent that one chamber was abandoned. The nest chamber is characterized by cuttings and excreta (Fig. 3). This chamber lies on a foundation of heavy sticks which are held together by accumulated deposits of excreta.

Not only does the rat add to his house during the year but changes are observed in the nest according to the season. During the late spring and summer months the nest is not oval as stated, but more of a saucer shape. As the season progresses the nest is reconstructed and again assumes an oval shape.

METHODS AND MATERIALS

Field Equipment.—The equipment used to collect the nests consisted of a pick-ax, heavy leather gloves, and large paper bags. The pick-ax was used to facilitate the tearing apart of the house in order

to obtain access to the nest. Heavy leather gloves were very useful when the house or nest contained thorns or other materials that might cause skin abrasions.

Each nest that was collected was placed in a paper bag, the top of which was sealed to prevent the escape of consortes. Six to eleven nests were collected each month from February, 1954 to January, 1955.* Only those nests showing evidence of occupancy were collected, this being statistically important both quantitatively and qualitatively.

Laboratory Methods.— In the laboratory, each nest was placed into a modified Berlese funnel and left for a twenty-four hour period. The consortes were collected in a catch-bottle containing 70 per cent ethyl alcohol, which was fitted to the base of the funnel. Sorting of the organisms was done by use of a medicine dropper under a dissection microscope.

The fleas were immediately processed and identified. All other consortes from each nest were segregated into various taxonomic groups, properly labeled, and preserved as separate units. This keeping of all consortes was done to facilitate further study, if desired, as it might relate to this project.

Flea Mounting Techniques.—The techniques used are:

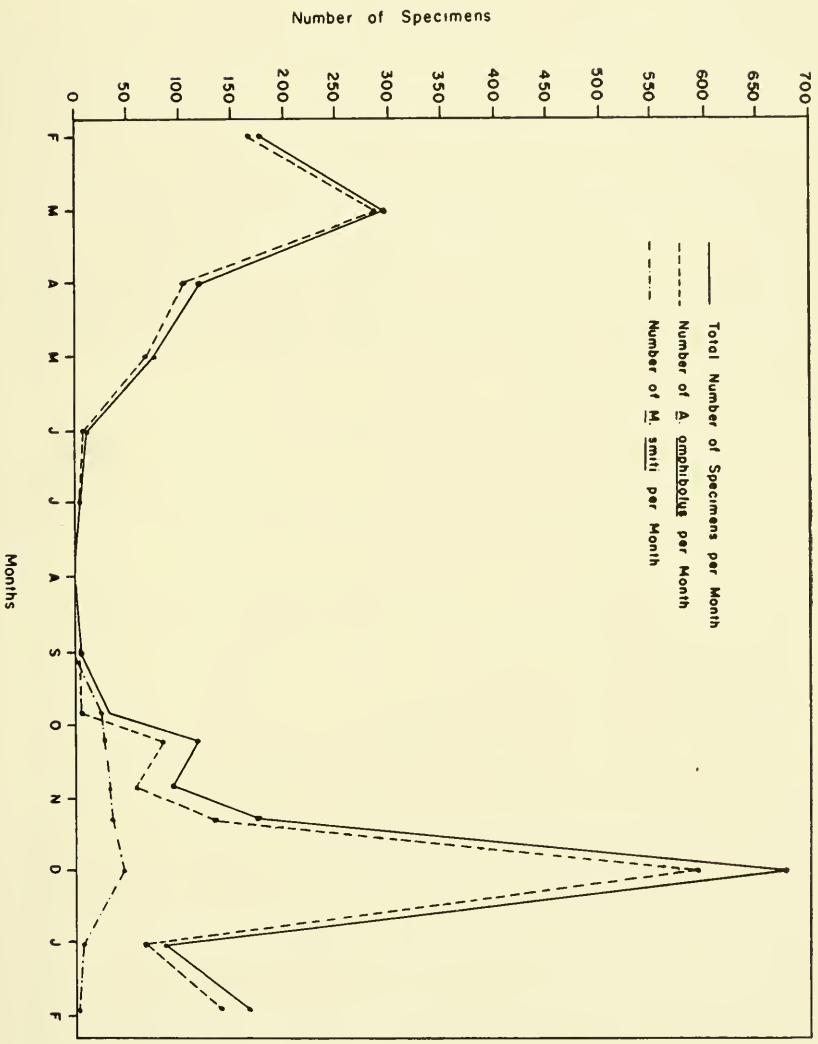
1. NaOH (five per cent) Remains in solution until cleared (24-72 hrs.)
2. Water (12 hrs.)
3. 50 per cent acid ROH (2 hrs.)
4. 70 per cent ROH (2 hrs.)
5. 85 per cent ROH (2 hrs.)
6. 95 per cent ROH (2 hrs.)
7. 100 per cent ROH (2 hrs.)
8. Oil of Wintergreen (12 hrs.)
9. Mount on microslide in clarite.

DISCUSSION

In 1939, Eskey and Haas indicated the importance of burrow openings and excavated nests in connection with flea populations. Since 1939 two detailed studies have been made concerning those species of fleas found in rodent burrows and also of the species found upon the host. The first, by Stewart and Evans (1941), establishes definite seasonal variations among those fleas in the burrow and on the host. The second, by Holdenried, Evans, and Longanecker (1951), was a continuation of the first and covered a five-year period (1940 to 1945). Both of the above studies were in agreement regarding the flea populations.

A number of species of nest and burrow inhabiting fleas have been implicated with plague transmission (Eskey and Haas, 1939). Therefore, from the standpoint of plague-vector relationship, it is

*During the summer months when no fleas were found extra nests were collected to test the validity of the sampling. Otherwise the sample was constant throughout the study. (See data sheet.)


Number of Specimens
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
F
M
A
M
J
J
A
S
O
N
D
J
F
Months
Total Number of Specimens per Month
Number of A. amphibolus per Month
Number of M. smiti per Month

important to recognize kinds of consortes located in nests and burrows of host organisms.

Hampton (1940) published an account showing the presence of plague organisms in *N. l. lepida.* With *N. l. lepida* implicated as a host animal for both the disease organism and the vector it was deemed important to observe population variations of implicated vectors as found in the nests of the host.

Beginning February 6, 1954, nest collections of the desert wood rat *(N. l. lepida)* were begun and extended over a period of twelve months, ending January 24, 1955. All collections were made in the Jericho area as stated. The 98 nests collected contained an average of twenty plus fleas per nest giving a total of 2023 specimens. Although there were only two predominant species (*Megarthroglassus smiti** and *Anomiopsylla amphibolus* Wagner), eleven species were identified from the collections.

They are:

Monopsyllus wagneri wagneri (Baker)
Monosyllus sp. **
Anomiopsylla amphibolus Wagner
Epitedia stanfordi Traub
Orchopeas sexdentatus agilis (Rothschild)
Orchopeas leucopus (Baker)
Atyphloceras echis Jordan and Rothschild
Thrassis gladiolis caducus (Jordan)
Meringis parkeri Jordan
Megarthroglossus smiti *
Malaraeus euphorbi (Rothschild)

Various species of fleas demonstrate greater or lesser host specificity. It is also known that some interchange in fleas constantly occurs between various hosts in nature. Such fleas not commonly found upon any given host may be identified as accidental or occasional parasites. In a study involving several months of observation it would be expected that a certain number of occasional or accidental flea parasites would be found associated with a given species of host. Likewise there would be found other species which would be quite host specific. With reference to the species in this study, it seems to be entirely evident that *A. amphibolus* is restrictive in host association to *N. l. lepida* and related species. Other authors have also found this to be the case (Hubbard, 1947; Holland, 1949). Not much is known about the new species *Megarthroglossus smiti* but it too seems to be restricted to *N. l. lepida* from data gathered to date. *M. w. wagneri* and *E. stanfordi* on the other hand are listed by most authors as being "mouse" fleas, most commonly found associated with species of the genus *Peromyscus.* Since the above two rodents live in close association in this area, occasionally finding an accidental host relationship can easily be understood.

*Eustorgio Mendez at Berkeley, California has recently completed an unpublished monograph of the genus *Megarthroglossus.* Specimens of this genus were sent to him for examination. He classified them as a new species which he named *M. smiti.*

**All specimens not identified to species were females. Specimens of this sex are sometimes difficult to accurately place to species in the absence of males.

Population trends for all species in this study are described in Fig. 5. Analysis of this graph indicates very definite seasonal differences. The late spring and early fall months show sparse population, the summer months showing no appreciable numbers of individuals as contrasted to the very high population density during the late fall and winter months.

The present study indicates that certain species appear seasonally predominant. *M. smiti* is predominant early, being the first flea to appear in the fall (September), leveling off in numbers during the winter and almost completely disappearing by late winter (February). *A. amphibolus* occurs in greatest numbers during late fall, winter, and spring, the peak coming between December and March (Fig. 5). The drop in population during January cannot be fully explained at present. The fact that no adult fleas of any species were found in the nests during the period from June to September is of special interest. This study and the study of Traub and Hoff (1951) are in agreement regarding summer populations. The ecological factors influencing the decrease in summer populations are unknown. *E. stanfordi* seems to be evenly distributed throughout the fall, winter, and spring. All other species related to this study have an irregular appearance.

Beck, Barnum, and Moore (1953) made a comparative nest consort study of *N. l. lepida* and *N. cinerea* (Ord) during the months of October and November of 1952. A comparison of their studies and those made by the author with regard to comparative seasonal populations is interesting. For the same period of time in both studies there was a close similarity in genera and species collected. Not only are the species similar but in many cases the number of specimens of a particular species are similar (Table I).

The species which do not follow the same population pattern in the two studies are *M. w. wagneri*, *M. euphorbi*, and *E. wemmanni*. *E. wemmanni* is represented by only one specimen and would seem insignificant to the study comparison. *M. w. wagneri* and *M. euphorbi* occurs frequently in the 1952 collections. are absent or nearly absent in the 1954 collections (Table I). Both species are commonly found on deer mice *(Peromyscus)* although they often are of accidental occurrence on many other species of rodents. Hubbard (1948) lists *Peromyscus* and *Neotoma* as common hosts of these two fleas. The association of the two rodents and their fleas would indicate a close relationship in this particular ecological situation. Thus, the study of Beck, Barnum, and Moore serves as a quantitative and qualitative check for the specific period compared.

ECONOMIC AND MEDICAL IMPORTANCE

Fleas are a definite menace to the health of man and animals, either as an entomophobia or as direct vectors of diseases. They are of wide distribution, numerous, and very definitely of parasitic habit in the adult stage. In the Rocky Mountain region, fleas are believed

to be common vectors of plague, tularemia, and typhus fever (Stark, 1948). Stewart and Evans (1941) said:

> "Because of the difference in seasonal distribution of fleas, collections should be correlated with those times of year when species capable of transmitting the infection are abundant. It is quite possible that many of those areas heretofore recorded as being free from plague infection have been placed in this category because they were surveyed at a time when efficient vectors had been largely replaced by species which are either very poor vectors or incapable of transmitting plague."

TABLE I

A COMPARISON OF THE FLEA POPULATION OF 1954 AND 1952 IN THE NESTS OF THE DESERT PACK RAT

SPECIES	Oct. 13, to Nov. 17, 1952	Oct. 8, to Nov. 12, 1954
	No. of Specimens	No. of Specimens
Anomiopsylla amphibolus	206	270
Orchopeas sexdentatus	6	1
Malaraeus euphorbi	45	2
Monopsyllus w. wagneri	18	0
Atyphloceras echis	5	2
*Megarthroglossus smiti**	34	97
Epitedia wemmanni	1	0
Epitedia stanfordi	34	8
Meringis parkeri	1	0

Fleas implicated with plague in the Western United States have been listed by Eskey and Haas (1939). A list of plague implicated fleas for Utah is found in the reports of studies conducted by Allred (1951) and Beck (1955). Of the fleas listed for Utah in the above reports, the following species have been found as consortes in the nests of *N. l. lepida* in this study:

Monosyllus w. wagneri
Orchopeas sexdentatus
Thrassis sp.

M. w. wagneri and *O. sexdentatus* are listed as potential vectors of plague, e.g. in the laboratory they experimentally transmit plague. *Thrassis* sp. is listed as a capable vector of plague, e.g. they are known to transmit plague in nature (Allred, 1951). The genus *Thrassis* is listed because several of the species of this genus outside of Utah have been proven plague positive (Allred, 1951). These same species do occur in Utah.

**Megarthroglossus d. divisus* collected in the 1952 study is synonomous with *M. smiti*.

This report has attempted to facilitate a better understanding of the problem of seasonal variations of flea populations. It has established data which can be used to accurately identify the seasonal variations in flea populations for such consortes in the nests of *N. l. lepida* in central Utah. Whether this data will be valid within other areas of the state is not known. Such information when applied to vectors of disease adds much to the understanding of ecological factors related to these vectors as has been mentioned above for plague. The same can be said for general disease ecology.

CONCLUSIONS

From the 2023 specimens of fleas collected over a twelve month period near Jericho, Juab County, Utah, two definite seasonal variations in populations have been found. The entire flea population analyzed statistically on a year's basis, indicated a relatively low population existed from May through September, while October through April displayed a comparatively high population of fleas.

The most abundantly collected species of flea which was taken was *A. amphibolus*. This is a flea which is not usually found in any great numbers on the body of the host animal, but occurs in abundance in the host nests at certain seasons of the year. Of the total number (1726) taken the peak population was reached in December. They gradually begin to thin out and completely disappear in July. They begin to reappear in late September.

A comparison of data between this study and one made by Beck, Barnum, and Moore for the months of October and November shows many points in common. The species listing and population figures are much in agreement.

With reference to the economic importance of this study it has been pointed out that of the eleven species, two *(O. sexdentatus* and *M. w. wagneri)* are defined by Eskey and Haas (1939) as being potential vectors while certain species of *Thrassis* are listed as being capable vectors of plague.

This study indicates that it is especially important to make year round collections in order to establish accurate distributional records for any locality. It is quite apparent that a single or several collections made in the summer months with respect to species found in this study would not have accurate representation from a distributional point of view. It likewise emphasizes the need for seasonal observations to gain a proper perspective in population index.

This study has revealed that the greater population of fleas found in the nests are not particularly implicated with plague. However, it is believed that some of these species of fleas are involved with other diseases as vectors, such as typhus and tularemia.

The general examination of all other consortes of the nests seems to show responses to reasonal variations as determined by the population index. Some of these consortes were: mites, soft-bodied ticks, hard-bodied ticks, spiders, pseudoscorpions, and other arthropods.

FIG. 4

Date Collected	*Anomiopsylla amphibolus*	*Monopsyllus wagneri wagneri*	*Epitedia stanfordi*	*Monopsyllus* sp.	*Orchopeas leucopus*	*Orchopeas sexdentatus agilis*	*Atyphloceras echis*	*Thrassis gladiolus caduceus*	*Meringis parkeri*	*Megarthroglossus smiti*	*Malareus euphorbi*	B.Y.U. Field Number Project X	Total Number Collected
Feb. 6, 1954	168	1	8									3817	177
March 13	293		1					1				3820	295
April 11	105	6	5			1			1			3828	119
May 8	69	1	3							2		3834	75
June 9	9	1										3838	10
July 8	4											3855	4
August 10												3885	
September 3	2											3916	2
September 29	4									27		3917	31
October 8	82		3				2			29		3918	116
October 29	54		3	2		1				33		3919	93
November 12	134	6	2							35	2	3920	174
December 2	595	2	22		7		7			46		3927	679
Jan. 7, 1955	68		5				2	1		8		3934	84
January 24	139		5			1	16			2		3935	163

Record of Specimens Collected

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Fig. 1. Study area, a typical sagebrush-juniper community.

Fig. 2. The woodrat house.

Fig. 3. Cutaway of woodrat house showing the position of nest (scalpel) and burrows.

NECROLOGY REPORT OF THE DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY ALUMNI, BRIGHAM YOUNG UNIVERSITY, 1955

VASCO M. TANNER[1]

During the past year, three alumni of the Brigham Young University Department of Zoology and Entomology have died. One of these members, Andrew T. Rasmussen, was 72 years old, while the other two were 36 and 37 years of age—too young to be cut short from their very promising careers. These two young scientists may well be listed as casualties of World War II. Staff members of the Brigham Young University have been built up and grown because of their association with these outstanding students in the field of biology, but saddened because of their untimely departure.

ANDREW T. RASMUSSEN
1883-1955

Andrew T. Rasmussen was born in Spring City, Sanpete County, Utah, August 10, 1883. He died at his newly established home in in La Canada, California, on October 15, 1955.

He received the degree of Bachelor of Arts from the Brigham Young University in 1909. Because of his outstanding accomplishments in this field, he was made assistant professor and then head of the Department of Biology of the University. He served in this capacity until the autumn of 1913, when he became instructor and graduate assistant in the Department of Physiology at Cornell University, from which institution he received the degree of doctor of philosophy in Anatomy and Physiology in 1916. This same year, Dr. Rasmussen was appointed instructor of anatomy at the University of Minnesota. Here he made rapid advancement in his chosen field, being advanced to the rank of Professor in 1925. He held this position until his retirement in June, 1952.

Dr. Rasmussen was an efficient, hard working scientist. While at Brigham Young University, he spent from 12 to 15 hours per day in the laboratory, producing many anatomical charts and thousands of histological slides. These well established habits of work characterized him through the remainder of his life. His books and scientific articles were enhanced by his accurate drawings and illustrations. His "Laboratory Directions in Neuro-Anatomy" is now in the third edition, while his "Outline of Neuro-Aantomy" has gone through the

1. Contribution No. 150 from the Department of Zoology and Entomology, Brigham Young University.

eighth printing of the third edition. One of the most widely used textbooks in the medical schools of the United States in neuro anatomy is his "The Principle Nervous Pathways." He also published many articles in scientific and medical journals. His little book, "Some Trends in Neuroanatomy," published by Wm. C. Brown Company, 1947, is a very complete and useful history of this subject.

As a teacher, Andrew T. Rasmussen was unsurpassed. During his thirty-five years of teaching at the University of Minnesota, between four and five thousand medical and postgraduate students sat in his classes. One graduate student said: "Of all medical courses I have taken anywhere, his was the best remembered and the one most actively participated in by the students." His demonstrations of well chosen specimens, which were gathered during his long teaching career, greatly enlivened his classes and made a lasting impression on his students.

Dr. Rasmussen had the companionship of Gertrude Brown, whom he married in 1911. She was the daughter of Professor James L. Brown of the Department of Education at Brigham Young University. From her early childhood, she was interested in nature study and loved the out-of-doors; this enabled her to be a great support and helper in all of her husband's biological activities. They are the parents of four children, all of whom are college graduates. When Dr. Rasmussen retired in 1952, the couple came west and made their home in La Canada, California. He accepted a visiting professorship with the Department of Investigation of Medicine, University of California at Los Angeles, which position he held until his death.

In June, 1953, at the 78th annual commencement of Brigham Young University, Dr. Rasmussen was honored with the distinguished service award. He also held membership in many of the learned societies of this country.

Andrew T. Rasmussen, whose grandparents and parents were sturdy Danish converts and members of the Latter-day Saint Church, made a most enviable local and national record for himself. His name is written near the top of the scroll of distinguished alumni of Brigham Young University.

LOWELL STORRS MILLER
1919-1955

Lowell S. Miller died December 12, 1955, in the St. Mary's Hospital at Rochester, Minnesota. He was born March 9, 1919, in Lehi, Utah, the son of Elmer and Rosella Storrs Miller. He made his home in Provo, where his father is head of the Department of Economics at Brigham Young University.

As a youth, Lowell was interested in entomology. During his high school years, he spent much time at the University learning the rudiments of collecting and preparing insects for a collection. He entered Brigham Young University as a freshman in 1936, pursuing a course in the natural sciences. In the spring of 1940, he volunteered

for military service and was sent to the Philippine Islands to serve with the U. S. Army weather service. He was captured on Bataan April 9, 1942, was a member of the ill fated "death march" and spent forty-one months as a Japanese prisoner of war. It was here he contracted the illness and underwent the hardship from which he never fully recovered.[2]

Lowell Storrs Miller

Upon being discharged, he returned to Provo and on December 1, 1945, married Blanche Thomas, daughter of John E. Thomas of Malad, Idaho. Lowell and Blanche are the parents of a son, Sheldon, and a daughter, Maryanne.

In the autumn of 1945, Lowell reentered the Brigham Young University, receiving a bachelor of arts degree in 1946 and a master of arts degree in 1947. He then did graduate work at the Stanford University Marine Station, the University of Illinois, and the University of Iowa. He was working on his thesis for a doctor of philosophy degree at the time of his death. Lowell Miller was an assistant professor of zoology at Parsons College, Fairfield, Iowa in 1948 and in 1949. He was a member of the University of Illinois Museum Expedition to Venezuela in 1950 and had served as ranger naturalist for the National Parks Service during the summer of 1951, prior to going to Davenport. He was appointed director of the Davenport Museum in 1951, which position he held until January of 1955, when he accepted the appointment as director of the Marathon County Historical Society and curator of the museum of Yawkey Home, at Wansau, Wisconsin.

Lowell Miller was affiliated with a number of professional and civic organizations, among which were memberships in the American Association of Museums, American Society of Systematic Zoology, the Iowa, Illinois and Wisconsin Academies of Science, and the American Society of Mammalogists.

2. He was closely associated with Harry P. Chandler, Harry Thomas, Ray Snow and James W. Bee, who were high school and boy scout friends and college companions. These five enthusiastic nature lovers majored in Zoology and Entomology. When World War II began, Miller, Snow and Thomas volunteered to serve their country. Miller and Snow were sent to the Philippine Islands and both became prisoners of war of the Japanese. Ray Snow died on the "death march" and was hastily buried by his buddy and companion, Lowell Miller, Harry Thomas was killed in war activities in Italy. Thus, today James W. Bee is the sole survivor of the five energetic devotees of scouting, hiking and learning first-hand about the nature lore of Utah Valley. James Bee is now a graduate student in Zoology at the University of Kansas.

Lowell earned the respect of those with whom he associated as well as people of the community. He was among the most promising of the alumni members from the Department of Zoology and Entomology. Staff members of the Department are saddened at his untimely passing. We extend our sincere sympathy to his wife, children and parents.

We are pleased to include the fine tribute paid to Lowell by the board members of the Marathon County Historical Society.

> "Lowell S. Miller came to Wisconsin last year as first director of Marathon County Historical Society. It was a crucial time: The Yawkey Home had just been acquired; successful establishment of a museum demanded increased membership, keen community and county interest.
>
> Miller possessed a tremendous vitality and wide professional experience. His knowledge had an amazing breadth, spanned from biology to photography, included conservation, natural history, archaeology. He came to Marathon County from Iowa where he had headed the Davenport Museum for three years, doubling membership and expanding program in the process. Miller had studied at Brigham Young, Stanford, Illinois and Iowa and he had spent 41 long months in World War II as prisoner of the Japanese.
>
> In Marathon County, Miller plunged wholeheartedly into every phase of community life. Under his leadership, the county historical society's year was one of continual success. At his death, Society members, and acquaintances up and down the county and throughout the state mourned the loss of an able leader and associate."

HARRY PHYLANDER CHANDLER
1917-1955

Entomologist and assistant Fisheries Biologist with the Trout Management Study of the Inland Fisheries Branch, California Fish and Game.

Harry P. Chandler died on April 16, 1955, after an illness of more than a year. He was born July 10, 1917, in Oregon. When Harry was a small boy, his mother moved to Provo. After completing high school, he entered the Brigham Young University in the fall of 1935.

Harry graduated with a bachelor of arts degree in 1939 and a master of arts degree in 1941 from the Department of Zoology and Entomology of Brigham Young University.

He continued his academic work by entering the graduate school of the University of California in the fall of 1941. Here his study activities were interrupted for the next four years, during which time he served in the navy, attaining the rank of Lientenant J.G. He was a gunnery and torpedo officer on a destroyer in the Pacific field of operations. When he was released from the service, he again entered the University of California, where he continued his work in entomology. He left the University in 1947 to join the Department of Fish and Game.

Harry Chandler was one of the most ambitious and capable students of the Coleoptera that we have had at the Brigham Young

University. He was a good collector and observer of the aquatic beetles. At the time of his death, he was also making progress in studying the Trichoptera of California. Harry's insect collection has been contributed to the California Academy of Sciences.

He is survived by his wife, La June Chandler and four children, who live at Red Bluff, California; also his mother and a sister who reside at Richmond.

Mr. Joseph H. Wales, a colleague of Harry Chandler's in the Inland Fisheries work, paid him the following tribute:

> ". . . By training and by aptitude, Harry was one of the most proficient biologists the Inland Fisheries Branch has ever had. His particular ability was aquatic entomology and he soon became a national authority in this field. In 1946-47, he worked at the University of California on a research fellowship collecting and classifying aquatic insects. He assisted Dr. R. L. Usinger of the Entomology Department in writing a syllabus for the first course on the Biology of Aquatic and Littoral Insects to be given in that Department, and later taught the laboratory portion of the course. Among the other scientific publications by Chandler are description of a new genus and five new species of aquatic insects. Several important scientific works were left unfinished when death cut short this promising career at the age of 37 years."
>
> *California Department of Fish and Game*, Vol. 41, No. 3, p. 348, 1955.

Among the scientific papers published by Mr. Chandler are the following:

1941 New species of Coleoptera from Utah (Omophronidae and Dytiscidae). *The Great Basin Naturalist*, Vol. II, No. 2, pp. 99-104.

1954a Four new species of Dobsonflies from California. *Pan-Pacific Entomologist*, Vol. XXX, No. 2, pp. 105-111.

1954b New Genera and species of Elmidae (Coleoptera) from California. *Pan-Pacific Entomologist*, Vol. XXX, No. 2, pp. 125-131.

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